Sample of Jaspilyte from Kokoko Lake
See "Iron Ores of Nipissing District."

REPORT OF

THE BUREAU OF MINES

1901

CONTENTS

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY OF ONTARIO.

Toronto:
Printed and Published by L. K. CAMERON,
Printer to the King's Most Excellent Majesty.
1901.

WARWICK BRO'S & RUTTER, Printers and Bookbinders,
TORONTO.

CONTENTS

Maps and Illustrations.

To His Honor the Honorable Sir Oliver Mowat, G. C. M. G.,

Lieutenant Governor of the Province of Ontario.

Sir :

I have the honor to transmit herewith, for presentation to the Legislative Assembly, the Tenth Report of the Bureau of Mines.

I have the Honor to be, Sir,

Your obedient servant,

E. J. DAVIS,

Commissioner of Crown Lands.

Department of Crown Lands,

Toronto, 21st March, 1901.

To the Honorable E. J. Davis,

Commissioner of Crown Lands.

Sir :

I beg to submit to you herewith for presentation to His Honor the Lieutenant-Governor the Tenth Report of the Bureau of Mines.

My predecessor in office, Mr. Archibald Blue, having been appointed to take charge of the census of Canada, with headquarters at Ottawa, resigned from the Bureau of Mines, 31st July, 1900. Mr. Blue was the first Director of the Bureau, having held the position continuously from March, 1891, when the growing importance of the mining industry of the Province led the Legislature to devote a branch of the public service to the promotion of its interests. As secretary and member of the Royal Commission on the Mineral Resources of Ontario, whose report published in 1890 has since become a classic, Mr. Blue enjoyed unusual opportunities of becoming acquainted with the mineral wealth of the Province, and the possibilities which lay before it when the vivifying touch of capital and enterprise should summon the industry to a vigorous development. The annual volumes which have been published since the establishment of the Bureau, while not neglecting the more scientific aspects of the subject, have sought to present information which miner and mine owner alike could turn to practical account, as well as to call the attention of capitalists to openings for profitable investment found in the various mineral fields of the Province. These reports, it may be said, are in active and constant demand, so much so that the earlier volumes, down to and including that for the year 1896, have long been out of print.

It was my good fortune to be associated with Mr. Blue as Secretary of the Bureau almost from the beginning ; and with the assistance of the present competent staff, it is my hope to continue the good work which has been going on during the past nine years.

The retirement of Mr. Blue took place at a time when the Assistant Commissioner of Crown Lands, Mr. Aubrey White, was in the old country for the purpose of recruiting his health, and when the duties of his position had for the time being devolved upon myself. To these exacting duties there were added on Mr. Blue's resignation those of acting Director of the Bureau of Mines ; but Mr. White's return about the end of August very much improved in health opened the way for giving effect to the necessary changes.

The Order in Council appointing me Director of the Bureau from 1st October, 1900, was followed in December by the appointment of Mr. W. E. H. Carter of Toronto to the position of Secretary of the Bureau, Mr. Carter thus taking the place of Mr. J. Watson Bain, B. A. Sc., of the School of Practical Science, who had for several months been filling the post of Secretary with much ability, but who elected to return to his duties on the teaching staff of the School. Mr. Carter is a graduate of the School of Practical Science, and after some experience in the gold fields of Western Ontario had been following his profession of mining engineer in British Columbia.

Mr. J. A. Bow, Inspector of Mines for the western portion of the Province, resigned his position in August, 1900, and it was deemed advisable that Mr. Carter before beginning work

in the Department should make a trip of inspection in that district which would also enable him to report upon the state of the mining industry there at the close of the year.

The staff of the Bureau in addition to the Director is now Mr. W. E. H. Carter, Secretary, Miss Anne Moffat, stenographer, Mr. D. G. Boyd, Inspector of the Michipicoton Mining Division, who spends the open months of the year at Michipicoton and the winter months at the Department; and also Prof. A. P. Coleman, Prof. Courtenay De Kalb, and Prof. W. G. Miller.

Dr. Coleman is attached as geologist and metallurgist to the Bureau of Mines, though his principal duties are those of professor of geology at Toronto University and of assaying and metallurgy at the School of Practical Science.

For many years Dr. Coleman has taken the field during the summer months in the work of geological exploration, and his reports on the geology and mineralogy of many portions of Northern and Western Ontario have been conspicuous features of the annual volumes of the Bureau. His papers in the present report on the Iron Ranges of the Lower Huronian, the Vermilion River Placers, and the Sea Beaches of Eastern Ontario, are valuable and interesting. Professors Miller and De Kalb, who are both members of the faculty of the School of Mining, Kingston, have likewise for some years employed their vacation months in work for the Bureau. The former has been specially engaged in investigating the corundum and iron ore resources of eastern Ontario, and his report in the present volume on the Iron Ores of Nipissing District is a companion paper to that of Dr. Coleman. Prof. De Kalb performs the duties of Inspector of Mines for Eastern Ontario, and the useful Manual of Explosives, which he prepared under the instructions of the late Director of the Bureau, is referred to elsewhere.

Since the year 1898 an assay office under the direction of the Bureau of Mines has been carried on at Belleville under the charge of Mr. J. Walter Wells, the object being to assist the mining industry by enabling prospectors and others to procure trustworthy assays of ores and minerals at prices which barely defray the cost. The office has answered its purpose well, and every year has done a larger amount of work than before.

There are now two diamond drills owned and operated by the Bureau, which are placed at the service of owners of mineral properties desirous of prospecting them, the cost of the work being divided between the Bureau of Mines and the owner of the property in the proportion of 35 and 65 per cent. respectively. The larger drill, capable of boring to a depth of 1,500 feet has been in the possession of the Bureau since 1894; the other, which has a capacity of 400 or 500 feet, was purchased last year. They have both been steadily at work, the former during the whole of the year, and the latter since it was purchased. Mr. E. K. Roche is mechanical superintendent of the larger, and Mr. Oscar R. Smith of the smaller drill.

During the year, Mr. T. J. Ryan and Mr. D. M. Brodie, the Crown Lands Agents at Sudbury and Massey Station respectively, were empowered to act as agents for the receipt of applications for mining lands in the townships convenient to their agencies. Maps, land rolls distinguishing between granted and ungranted lands, and other records have been supplied them for the use of the public. No fee is demanded for consulting these records, and the agents report that prospectors and mining men generally much appreciate the opportunity thus afforded them of

obtaining information without expense or delay. Mr. L. C. Charlesworth has been acting as Mining Lands Agent of the Department at Rat Portage with similar duties for several years.

With the growth of the mining industry the work of the Bureau is steadily increasing. There is a heavy correspondence on all matters of interest to the mining community. Inquiries are received from persons in the United States, Great Britain, Canada and elsewhere desirous of procuring supplies of particular minerals ; and persons who have minerals or more frequently undeveloped deposits for sale, write to the Bureau to be placed if possible in communication with purchasers. Many questions as to the mining laws have to be answered ; there is a constant stream of applications for the Bureau's reports and for information which those reports supply ; the supervision of the diamond drills necessitates considerable care and letter-writing ; claims on the Iron Mining Fund have to be examined and checked ; mining accidents investigated ; and since the close of the year the collection and preparation of an exhibit of the minerals of the Province for the Pan-American Exposition opening at Buffalo, N.Y., 1st May next has demanded a good deal of time and attention. For the last-named work the services of Mr. Frank N. Speller have been engaged, and with his active assistance it is hoped to make a creditable showing. This is in addition to the collection of statistical and other information respecting the mining industry of the Province for publication in the annual report, which must necessarily remain the chief reason for the Bureau's existence.

Statistics of the output of the metalliferous mines and works of the Province for the first three months of 1901 have been collected while this report has been going through the press, and are given herewith. The aggregate value of the output was $827,860, showing a large proportional increase as compared with the whole of the year 1900, for which time the yield of the same products was $2,541,131.

		1901 3 months.	1900 12 months.
Gold:			
Ore treated	Net tons	10,174	46,618
Gold product	Ounces..	3,150	18,767
Value of gold	$	54,520	297,861
Silver:			
Silver product	Ounces..	20,077	160,612
Value of silver		12,046	96,367
Nickel and Copper:			
Ore raised	Net tons	72,036	216,695
Ore smelted	"	36,706	211,960
Matte product	"	5,832	23,336
Nickel in matte	"	903	3,540
Copper in matte	"	840	3,364
Value of nickel	$	190,858	756,626
Value of copper	"	75,625	319,681
Iron Ore	Net tons	35,503	90,302
Value at mines		44,106	111,805
Pig Iron:			
Ontario ores	Net tons	21,083	22,887
Foreign ores	"	27,580	77,804
Mill cinder, etc	"	3,486	13,092
Pig iron product	"	28,694	62,386
Value of pig iron	$	438,659	936,066
Arsenic	lbs	236,054	606,000
Value	$	12,046	22,725

The largest increases are in iron ore and pig iron ; nickel and copper remain at about the same level of production ; arsenic shows a decided increase, while gold and silver have fallen off.

The quantity of iron ore smelted into pig iron during the quarter at the three furnaces in Ontario, all of which are in steady operation, was 48,663 net tons, of which 21,083 tons were from Ontario mines and 27,580 tons were imported ore. The proportion of native ore smelted during the quarter rose to 43 per cent. of the whole, as against 23 per cent. in 1900. In addition to the ore 3,486 tons of scale and mill cinder were smelted.

The total quantity of nickel and copper ore mined during the three months was 72,036 tons, being a proportional increase as compared with the whole of 1900 of 31 per cent. The quantity smelted was 36,706 tons.

I have the honor to be, Sir,

Your obedient servant,

THOS. W. GIBSON,

Director.

Office of the Bureau of Mines,
Toronto, 21st March, 1901.

TENTH REPORT OF THE BUREAU OF MINES.

BY THOS. W. GIBSON, DIRECTOR.

The year 1900 was characterized by a healthy growth in the mining industry of Ontario as a whole. Probably greater advances were made in some of its branches than in any previous year, notably in the production of iron, nickel and copper, in all of which progress was most satisfactory. On the other hand, the output of gold was smaller than in 1899. There was a subsidence of the speculative excitement which for some time previous had marked the public interest in mining affairs, as shown by the shorter list of joint stock companies formed for mining purposes, and the smaller aggregate of nominal capital, as compared with 1899. The companies organized during the year were :—

Name of Company.	Head Office.	Date.	Capital.
The A.L. 282 Gold Mining Company of Ontario, Limited	Port Arthur	23 February, 1900.	$1,000,000
" Atikokan Iron Company, Limited	Fort William	30 June, 1900	1,000,000
" Bag Bay Gold Mines Company of Ontario. Limited	Rat Portage	31 January, 1900	999,999
" Baird Mining Company, Limited	Toronto	30 June, 1900	1,000,000
" Black Jack Zinc Syndicate of Ontario, Limited	Toronto	16 May, 1900	100,000
" Calco King Mining Company, Limited	Sarnia	24 April, 1900	25,000
" Canadian Portland Cement Company, Limited	Toronto	23 May, 1900	1,500,000
" Cataraqui Mining and Developing Company, Limited.	Ottawa	16 August, 1900	400,000
" Central Peat Company, Limited	Toronto	28 March, 1900	50,000
" Clarendon Mining Company of Ontario, Limited	Windsor	16 August, 1900	1,250,000
" Colonial Mines Company of Ontario, Limited	Windsor	21 March, 1900	750,000
" Crown Corundum and Mica Company, Limited	Toronto	1 August, 1900	1,000,000
" Durham Portland Cement Company, Limited	Durham	10 November, 1900	150,000
" Gibraltar Mining and Development Company of Ontario, Limited	Toronto	7 June, 1900	1,000,000
" Grey and Bruce Portland Cement Company of Shallow Lake, Limited	Owen Sound	31 March, 1900	199,000
" Hanover Portland Cement Company. Limited	Hanover	7 December, 1900.	150,000
" Jack Lake Gold Mining Company, Limited	Toronto	7 February, 1900.	100,000
" Kitchi-Gammi Gold Mining Company, Limited	S. S. Marie	21 September, 1900	1,000,000
" Lakefield Portland Cement Company, Limited	Owen Sound	11 August, 1900	500,000
" Lanark County Peat Fuel Company, Limited	Perth	11 July, 1900	30,000
" Leo Mining and Developing Company, Limited	Toronto	16 April, 1900	5,000,000
" Lichen Island Mining Company, Limited	Sarnia	31 January, 1900	995,000
" "Little Bobs" Mining Company of Ontario, Limited.	Rat Portage	23 June, 1900	1,000,000
" Main Mining Company of Ontario, Limited	Toronto	23 May, 1900	250,000
" Manhattan Gold Mining Company of Manitou, Ontario, Limited	Brockville	24 February, 1900.	40,000
" Mississauga Mining Company, Limited	Toronto	31 January, 1900	80,000
" Monarch Mining Company, Limited	Toronto	17 January, 1900	990,000
" Moose Lake Mining and Milling Company, Limited	Cornwall	31 January, 1900	1,000,000
" Niagara and Georgian Bay Mining and Development Company, Limited	St. Catharines	17 September, 1900	1,000,000
" Nino Mining Company, Limited	Toronto	6 July, 1900	1,000,000
" North West Gold Dredging Company, Limited	Ottawa	14 December, 1900.	1,000,000
" Pic Copper and Gold Mining Company of Lake Superior, Limited	Toronto	15 March, 1900	1,900,000
" Pine Portage Mining Company, Limited	Hamilton	11 July, 1900	80,000
" Port Arthur Iron Company, Limited	Toronto	4 January, 1900	20,000
" Powell Granite Company, Limited	Toronto	15 February, 1900.	20,000
" Reliance Gold Mining Company, Limited	Windsor	25 April, 1900	1,250,000
" Shawinigan Carbide Company, Limited	Toronto	4 January, 1900	1,000,000
" Southern Ontario Peat Company, Limited	Brantford	4 January, 1900	100,000
" Stadacona Gold Mining Company, Limited	Ottawa	7 April, 1900	1,000,000
" Stobie Mining Company, Limited	S. S. Marie	28 November, 1900	1,000,000
" Sultana-Ophir Mining Company, Limited	Toronto	24 January, 1900	10,000
" Sun Portland Cement Company, Limited	Owen Sound	31 May, 1900	500,000
" Tip Top Copper Company of Ontario, Limited	Toronto	21 September, 1900	1,000,000
" United Mining Company, Limited	Niagara Falls	5 September, 1900	1,250,000
" Welland County Lime Works Company, Limited	Port Colborne	14 December, 1900.	30,000
" Wendigo Mines of Ontario, Limited	Toronto	27 June, 1900	1,000,000
" Western Peat Fuel Company, Limited	Chatham	23 March, 1900	100 000
" Wonderly Gold Mining Company, Limited	Welland	11 July, 1900	1,000,000

Companies organized during the year.—*Continued.*

Name of Company.	Head Office.	Date.	Capital.
LICENSED MINING COMPANIES.			
Anglo-Canadian Gold Estates, Limited	9 Pancras Lane, London, Eng.	14 March, 1900	£ 61,000
The Bruce Copper Mines, Limited	Bruce Mines, Ont	17 October, 1900	£100,000
Cordova Exploration Company, Limited	Hebburn, Coy Durham, Eng.	25 January, 1900	£60,000
Interstate Consolidated Mineral Company, Limited	Boston, Mass	5 May, 1900	$700,000
The Mond Nickel Company, Limited	London, Eng	16 October, 1900	£600,000
The Ontario Mining Company, Limited	Rat Portage	30 November, 1900	$ 20,000
Quebec Mining Company	Quebec	31 March, 1900	60,000
The Rainy River Development Company, Limited	Rat Portage	24 October, 1900	300,000
The Windsor Salt Company, Limited	Windsor	21 December, 1900.	200,000

The number of companies chartered under the laws of this Province was 48, having an authorized capital of $35,818,999, as compared with 74 companies with a capital of $87,382,994 in 1899. In addition to the corporations taking out original charters in Ontario, 9 companies mainly of English and American origin took out licenses to sell stock and carry on business here, whose capital stock amounted to $6,585,000.

MINING LANDS SOLD AND LEASED.

Crown lands disposed of under the provisions of the Mines Act amounted to 30,972 acres sold and granted under 257 patents, the purchase money received for which was $69,195.79. The mining leases issued numbered 267, covering 28,127 acres, for which the first year's rental was $27,970.90. The receipts on account of sales and rentals of mining lands were $102,151.96, which includes the sum of $8,326.39 received as rental on leases issued prior to last year. To this must be added $6.800.55 collected as fees for miner's licenses in the Michipicoton Mining Division, prospector's licenses, etc., making the total receipts from mining lands $108,952.51.

MINING LANDS SOLD.

District.	Sales.	Acres.	$
Rainy River	176	17,606	36,206 15
Thunder Bay	26	5,314	11,511 50
Algoma	26	2,795	6,451 81
Elsewhere	29	5,257	15,026 33
	257	30,972	69,195 79

MINING LANDS LEASED.

District.	Leases.	Acres.	$
Rainy River	147	13,585	13,585 00
Thunder Bay	38	4,920	4,920 00
Algoma	43	5,357	5,354 50
Elsewhere	39	4,265	4,111 40
	267	28,127	27,970 90

MINERAL PRODUCTION.

The output of minerals for 1900 as reported to the Bureau, together with the number of workmen employed and wages paid for labor, is shown in the table given below.

SUMMARY OF MINERAL PRODUCTION IN 1900.

Product.	Quantity.	Value. $	Employes.	Wages. $
Building stone, rubble, etc	....	650,342	1,688	535,000
Cement, natural rock ..... bbls.	125,428	99,994	90	32,760
" Portland ..... "	306,726	598,021	535	166,143
Lime ..... bush.	3,893,000	544,000	710	171,300
Drain tile ..... number	19,544,000	209,738	3,312	647,856
Common brick ..... "	240,430,000	1,379,590		
Pressed brick and Terra Cotta ..... "	11,561,600	114,419	209	58,855
Paving brick ..... "	2,710,000	26,950		
Sewer pipe	....	130,635	87	32,197
Pottery	....	157,449	162	42,480
Petroleum ..... Imperial gals.	23,381,783	....	347	163,077
Illuminating oil ..... " "	11,783,755	1,076,242		
Lubricating oil ..... " "	1,980,428	232,805		
Benzine and Naphtha ..... " "	1,463,599	174,346		
Gas and fuel oils and tar ..... " "	3,669,102	200,934		
Paraffin wax and candles ..... lbs.	4,599,683	184,718		
Natural gas	....	392,823	161	43,636
Carbide of calcium ..... tons	1,005	60,300	32	15,898
Salt ..... "	66,588	324,477	243	72,584
Gypsum and products of ..... "	1,095	18,050	28	10,300
Talc ..... "	1,000	5,000	5	1,210
Graphite ..... "	1,802	27,030	25	13,296
Mica ..... "	643	91,750	133	33,972
Corundum ..... "	60	6,000	35	10,000
Felspar ..... "	4,000	5,000	25	3,900
Iron ore ..... "	90,302	111,805	439	107,583
Pig iron ..... "	62,386	936,066	419	97,915
Steel ..... "	2,819	46,380		
Nickel ..... "	3,540	756,626	1,444	728,946
Copper ..... "	3,364	319,681		
Zinc ore ..... "	500	500	5	2,179
Arsenic ..... lbs.	606,000	22,725	750	351,514
Gold ..... oz.	18,767	297,861		
Silver ..... "	160,612	96,367	50	24,000
Totals	....	$9,298,624	10,934	$3,366,601

The following table gives a comparison of the values of mineral products in 1898, 1899 and 1900:—

Product.	1898	1899	1900
	$	$	$
Building stone, rubble, etc	750,000	[1]667,532	650,342
Cement, natural rock	74,222	117,039	99,994
Cement, Portland	302,096	444,227	598,021
Lime	308,000	535,000	544,000
Drain tile	225,000	240,246	209,738
Common brick	914,000	1,313,750	1,379,590
Pressed brick and terra cotta	100,344	105,000	114,419
Paving brick	....	42,550	26,950
Sewer pipe	93,717	138,356	130,635
Pottery	155,000	101,000	157,449
Petroleum products	1,243,490	1,747,352	1,869 045
Natural gas	301,600	440,904	392,823
Carbide of calcium	55,976	74,680	60,300
Salt	278,886	317,412	324,477
Gypsum	4,000	16,512	18,050
Graphite	6,000	16,179	27,030
Talc	....	500	5,000
Mica	7,500	38,000	91,750
Corundum	....	....	6,000
Felspar	....	....	5,000
Iron ore	48,875	30,951	111,805
Pig iron	530,789	808,157	936,066
Steel	....	....	46,380
Nickel	514,220	526,104	756,626
Copper	268,080	176,237	319,681
Zinc ore	....	24,000	500
Arsenic	....	4,842	22,725
Gold	275,078	424,568	297,861
Silver	51,960	65,575	96,367
Totals	$7,235,877	$8,416,673	$9,298,624

The total value of the output in 1900 was $881,951 more than in 1899, an increase of 10 per cent. The number of workmen employed and the amount paid in wages were respectively 9 per cent. and 15 per cent. in excess of the figures for last year. The chief increases were in Portland cement ($153,794), petroleum products ($121,693), iron ore ($80,854), pig iron ($127,909), nickel ($230,522) and copper ($143,444); and the main decreases in natural gas ($48,081) and gold ($126,707).

[1] The production of building stone, rubble, etc., was erroneously given in 1899 as amounting to $1,041,350.

A glance at the foregoing table will show that there has been continuous, if not rapid, expansion in the value of the mineral production of the Province during the last three years; and there is reason to believe that the rate of increase will be maintained, if not accelerated during 1901, since a number of important enterprises which have hitherto been in the development stage will no doubt contribute to the production of the present year. Further inspection will also reveal the fact that the mineral products of Ontario are increasing in variety as well as in bulk and value. In last year's report the remark was made that during the eight years 1892 to 1899 paving brick, sewer pipe, carbide of calcium, graphite, talc, arsenic, iron ore, pig iron and zinc had been introduced as new products of the mineral industry. The statistics for 1900 add three substances to this list, namely, corundum, felspar and steel, the united output of which last year amounted to $57,380. The last of these is entered in the table of production as having a value of $46,380. Strictly speaking, perhaps, this sum should be eliminated from the aggregate of value for the year, since the pig iron from which it was made is already reckoned in, or at most only the additional value created by the conversion of the iron into steel should be taken note of; but the same reasoning would exclude iron ore smelted in the Province, and as the amounts involved are as yet comparatively small, it has not been thought expedient for the present to make any change in the method of enumeration.

Statistics and their Collection.

A word may be said here as to the collection of statistics. On the whole, the miners and producers of minerals make prompt and satisfactory returns of their output, as they are required by law to do, both for the several quarters of the year and for the twelve months ending 31st December. Occasionally, however, the information is delayed, or grudgingly given, or furnished only in part; and it is therefore difficult to publish the returns for the quarter or year as promptly after the conclusion thereof as is desirable. In a few instances the figures of output and value received are viewed with misgivings founded on other sources of information, yet no recourse is open but to accept them since they are certified as correct, and are supplied by those who are in a position to know the facts, namely, the producers themselves. Now, no argument is needed at this day to prove the value of statistics. They are to any industry what the physician's thermometer is to his patient, or the barometer to the weather. By their rise or fall, the increases, decreases or changes which they chronicle, they reveal the state of the industry to which they relate, and indicate what, if any, steps are necessary in order to stimulate growth or arrest decay. But to serve their purpose statistics must be at least approximately correct. Dealing with the aggregate of the mineral production of the Province, there is no reason to doubt that the statistics published annually by the Bureau answer this description. Certainly, no effort is spared to achieve complete accuracy, and if there is any failure it is chargeable not to want of diligence in attempting to obtain the facts, but to neglect on the part of owners of mines or works, or disinclination to impart the truth due either to the fear that business interests would be injured by making correct returns, or to some other similar motive. Such a policy is at best a short-sighted one and apt to lead to its own defeat; and it is gratifying to be able to state that it does not obtain to any extent in the mining industry of the Province.

It has sometimes been urged that returns of production should be published from individual mines and works, and it has been alleged that the adoption of such a course would tend to the investment of capital in mining enterprises by furnishing the details for which investors naturally look. Another reason advanced is that it would afford a measure of protection to the shareholders of any mining company whose management might be inclined to withhold information or misrepresent the facts.

It is no doubt true that detailed statistics showing, for instance, number of tons of ore treated, yield of metal or other product, value of same, expense of working, etc., published

monthly or quarterly, would be of interest and value, if the figures covered a considerable number of steadily producing mines of the same kind, say of gold. But at the present stage of the industry in Ontario, when steady production of bullion is not the rule among the gold mines, even those equipped with stamp mills, and where a great deal of the work done is of a prospecting and experimental character, publication of such particulars would be of little service to investors, and might even lead to erroneous impressions as to the value of particular properties. When a considerable number of mines are yielding their quota of gold day in and day out the year round and the industry has established itself on a permanent and satisfactory basis, detailed statistics of individual properties will cover a field large enough and a variety of circumstances great enough to possess real worth as a guide for the prospective investor, and there will then be much less difficulty in procuring them than there would be now. As to safeguarding the interests of shareholders or the public who buy mining stocks, still confining the case to gold mines, it may be said that the four mines now regularly turning out gold are all worked by English capital, and that none of their stock is for sale on the Canadian market.

One word more, as to the method of valuing the products of mines or works. The basis is adhered to which has been used from the beginning, namely, the selling value at the mine or works. For example, the nickel and copper contents of the nickel-copper matte produced at the Sudbury mines are computed on the market value of these metals in the matte at the smelters as returned by the producers, not on the selling prices of refined nickel and copper in the New York or any other market. The ground of this is evident, for the matte leaves the smelters in that condition, to be refined elsewhere, mostly in the United States, and hence the only value which can be taken into account for statistical purposes in this Province is the value which it has before being loaded on the cars for export. To compute the metallic contents of the matte at the value of the refined metals when the refining is done outside the Province would be as reasonable as to reckon all the wool shipped out of Canada at the price of cloth, all the pulp at the price of paper, or all the wheat at the price of flour.

Building Materials and Clay Products.

The aggregate value of the building materials produced during the year, including under this term stone, lime, common brick, pressed brick and terra cotta was $2,689,351, as compared with $2,621,282 in 1899, an increase of $67,069. An error crept into the statistics of building stone and rubble for 1899 by which the value of the product was given as $1,041,350 instead of $667,532. The comparative table for the last two years is as follows :

	1899	1900
Building stone, rubble, etc.	$ 667,532	$ 650,342
Lime	535,000	544,000
Common bri k	1,313,750	1,379,590
Pressed brick and terra cotta	105,000	114,419
Totals	$2,621,282	$2,688,351

Judging from these figures the building trade remained in a fairly active condition. Part of the increase is due to a rise in prices, the average cost of lime per bushel in 1900 being 13.9 cents as against 12.3 cents in 1899, and common brick being valued at 5.73 per thousand as against $5.61 in 1899. The output of other clay products for the two years compares as follows, drain tile, paving brick and sewer pipe showing a falling off which is more than made up by an increase in pottery.

	1899	1900
Drain tile	$ 240,246	$ 209,738
Paving brick	42,550	26,950
Sewer pipe	138,356	130,635
Pottery	101,000	157,449
Total	$ 522,152	$ 524,772

Cement.

The manufacture of cement continues to expand, the total production of 1900 being much larger than in any previous year. The increase is wholly in Portland cement, the natural rock variety being smaller in output and value than in 1899. The raw materials for an excellent quality of Portland cement—marl and clay—being so abundant in Ontario and the demand for pavement and construction purposes being so great and constant, there is every likelihood that the production will continue to increase. The number of cement works reporting to the Bureau last year was nine, of which four made natural or rock cement and five Portland cement. In addition to the factories now in operation, one or two others will place their product on the market during 1901. The detailed statistics for 1900 are as follows :

Kind of Cement.	Number of works.	Number of workmen.	Wages for labor.	Product, bbls.	Value of product.
			$		$
Natural rock	4	90	32,760	125,428	99,994
Portland	5	485	166,143	306,726	598,021
Totals	9	575	198,903	432,154	698,015

There was an increase in the total quantity of cement produced in 1900 as compared with 1899 of 70,117 barrels and in value of product of $136,749. The average price at which the cement was reported to the Bureau was 79 cents per barrel for natural rock and $1.95 for Portland, as against 84 cents and $2.00 per barrel respectively in 1899. That the home market is not by any means wholly supplied by the product of Ontario works is proven by the fact that during the fiscal year ending June 30, 1900, the imports of cement into Canada amounted to 1,312,170 cwt. as follows :

	Value.
From Great Britain	$249,280
" United States	55,569
" Belgium	156,213
" Germany	59,331
" other countries	200
Total	$520,593[1]

The duty paid on the importations was $151,075.06.

It is worthy of note that a marked change took place during the year in the proportion of cement imported from the several countries of origin. In the 12 months ending 30 June, 1899, the imports were :

	Value.
From Great Britain	$125,778
" United States	52,878
" Belgium	232,434
" Germany	73,135
" other countries	146
Total	$484,371[1]

It will be seen that the imports of Belgian and German cement which had risen from $79,370 and $15,603 respectively in 1896 received a decided check, while those from Great Britain were almost doubled, and constituted even a larger proportion than in 1896 when they were $123,436 worth out of a total importation of $252,882. The preferential tariff, whatever may be its operation with respect to other articles, certainly seems to be effective with cement.

[1] Rep. Dept. Trade and Commerce, 1900, part i, p. 224.

NEW CEMENT PLANTS.

A plant having a capacity of 500 barrels a day is nearly completed at Marlbank, replacing the works recently destroyed by fire. The mixing is done in a wash mill, followed by slurry tube-grinders. For burning, rotary calciners are used, 6 feet in diameter and 60 feet long, the fuel being ground coal. This is the first time this system of clinkering has been employed in Canada. The clinker will be ground in ball mills and tube mills, the latter yielding a product 95 per cent. of which will pass through a 100-mesh sieve. Tests on the cement from the marl and clay obtained at Marlbank showed a strength of 468 lbs. per square inch after 5 days. The analyses of marl and clay are as follows :

	Marl.	Clay.
Organic matter	1.12 per cent.	.... per cent.
Silica	0.46 "	53.32 "
Iron oxide and alumina	0 44 "	24.22 "
Calcium carbonate	97.21 "	12.80 "
Magnesium	0.63 "	4.27 "

The works are being erected by the Canadian Portland Cement Company, Limited, of Deseronto, successors to the Rathbun Company and the Beaver Portland Cement Company.

A corporation to be known as the Orangeville Cement Company is being organized to erect a 500-barrel plant at Orangeville. The property is now controlled by T. Rowan, D. B. Brown, John Rowan and H. Gillespie of Orangeville. It consists of 350 acres, situated in the fourth and fifth concessions of the township of Caledon, Peel County, and in concession B of the township of East Garafraxa, Dufferin County. The marl is overlaid by peat varying from 2 feet to 6 feet 6 inches in thickness, the marl itself having an average thickness, as shown by borings, of 13 feet. The deposit of clay is found on lot 1, concession B, East Garafraxa, having a depth of 6 feet over an area of 20 acres. Three analyses of the marl are reported as follows :

	1.	2.	3.
Moisture, etc	7.20	10.53	7.10
Silica	.90	1.36	1.30
Ferric oxide	.94	1.68	1.40
Lime (CaO)	52.04	46.49	50.06
Magnesia (MgO)	1.60	.54	.80
Alkalies	.60	tr.	tr.
Sulphuric acid	tr.	.54	tr.
Carbonic acid (CO)	36.72	38.94	39.34
	100.00	100.02	100.00

The analysis of the clay is given below :

	Top clay.	Bottom clay.
Organic matter	17.27	7.57
Silica	42.30	53.80
Alumina	17.20	23.26
Ferric oxide	5.10	3.71
Lime ($CaCO_3$?)	16.58	8.96
Magnesia ($MgCO_3$?)	.68	1.73
Alkalies	.35	.50
Sulphuric acid	.52	.47

The average of the clay after burning showed the following composition :

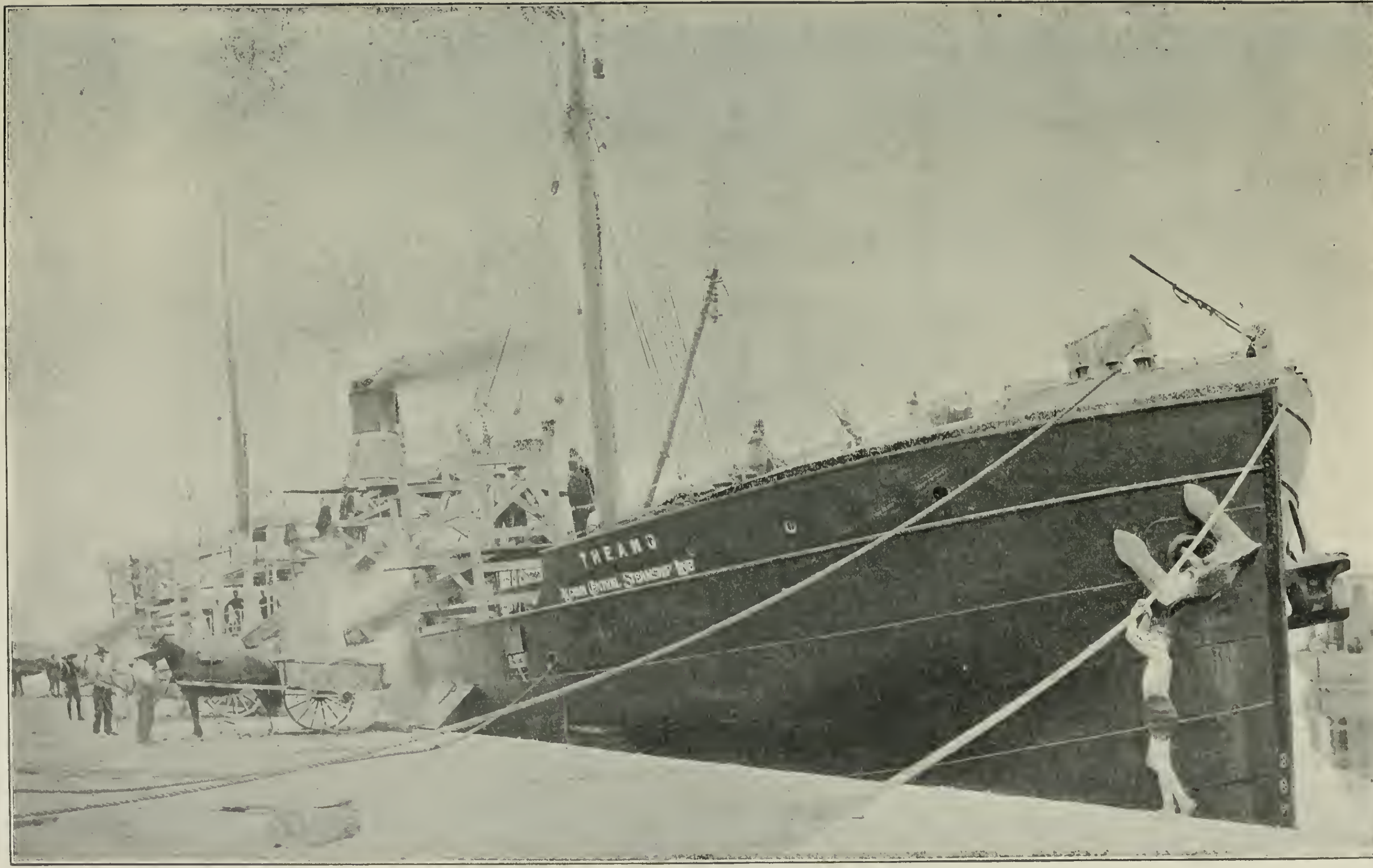
Silica	54.96
Alumina	23.09
Ferric oxide	5.03
Lime	14.57
Magnesia	1.37
Alkalies	.48
Sulphuric acid	.57

The properties are situated $2\frac{5}{8}$ miles from Orangeville station on the Canadian Pacific Railway.

The Georgian Bay Portland Cement Company, Limited, of Owen Sound, has undergone a change of name, being now called The Imperial Cement Company, Limited, manufacturing what is known as the Imperial brand of Portland cement. Its capital stock is $250,000, and

[1]

Smelting Works and Wharf, Canada Iron Furnace Company, Midland.



[2] First Canadian Ore Boat discharging Canadian Iron Ore at a Canadian Port. (Midland, July 1900).

its principal officers are, president, M. Kennedy ; vice-president, H. B. Harrison ; secretary-treasurer, J. W. Maitland. The plan of the works has also been very materially altered, and the capacity has been raised to 600 barrels per diem. The present system consists in mixing the marl and clay, after drying and grinding, securing the proper proportions, and then making this into brick, which are dried in Cummer dryers, burnt in Alborg kilns, and ground in the ordinary way, using tube mills for the fine grinding.

A company has been organized to erect a large cement works with a capacity of 600 barrels a day at Lakefield near Peterborough. The corporation is styled The Lakefield Portland Cement Company, Limited, with a capital stock of $500,000. The president of the company is Mr. J. M. Kilbourn of Owen Sound. The property, comprising 800 acres of marl land showing marl where tested 20 feet deep is situated on Buckley's Lake, two miles from Lakefield. The town of Lakefield has granted the company 13 acres of land, a bonus of $10,000, and exemption from taxation for a period of 10 years.

It is proposed to utilize the large marl beds near Durham in the County of Grey by erecting a cement factory at that place with a capacity of 1,000 barrels per day, for which purpose a Company has been organized.

A cement mill is also projected at Crookston in the County of Hastings.

Petroleum and its Products.

There was a slight shrinkage in the output of crude petroleum in 1900 compared with the previous year, the figures being 23,381,783 Imperial gallons as against 23,615,967. The total value of the substances refined from the oil was considerably larger, being $1,869,045 compared with $1,747,352. The following table gives the details :

	1899.	1900.
Illuminating oil	$ 1,059,485	$ 1,076,242
Lubricating oil	189,294	232,805
Benzine and naphtha	148,963	174,346
Gas and fuel oils and tar	213,544	200,934
Paraffin wax and candles	136,066	184,718
Total	$1,747,352	$1,869,045

An examination of the returns for the two years to ascertain the proportions of the various products of distillation to the total quantity of crude oil distilled shows an increase of nearly one per cent. in the yield of illuminating oil, and other changes as follows :

	1899.	1900.
Illuminating oil	49 53 per cent.	50.39 per cent.
Lubricating oil	8.84 "	8.47 "
Benzine and naphtha	5.90 "	6.25 "
Gas and fuel oils and tar	22 91 "	15.69 "
Paraffin wax and candles	11.85 "	19 66 "

There was a decided diminution in the quantity of gas and fuel oils as compared with 1899 and a corresponding increase in the production of paraffin wax and candles. The falling off in gas oils is explained by Mr. Charles Jenkins of Petrolea, a recognized authority on petroleum, as due to the fact that crude oil is now largely used instead of gas oil in the making of gas. For a long time crude could not be employed to advantage for this purpose, because too much free carbon was generated in the retorts, which ultimately choked up the mains and blackened the ceilings and walls of rooms. The art of retorting has so far advanced that this difficulty has been overcome, and gas men on equal terms now prefer crude to the product of crude, gas oil.

The limits of the petroleum-bearing area have not undergone much change during the year. Operations are being extended in the township of Plympton, and Bothwell keeps up its production, but as the territory is small it cannot be much increased, while Euphemia and Dawn simply maintain their output. More or less drilling goes on in the outskirts of the old Petrolea territory, but production is not much increased thereby. At Dutton some development has

taken place, and one or two strikes were reported from new territory which were not afterwards confirmed. There are reasonable grounds for believing that oil pools exist in the southwestern peninsula elsewhere than in the localities now producing, but time and risk of loss are involved in an attempt to induce nature to rev al her secrets.

The demand for oil products keeps constantly increasing, and prices last year were fairly well maintained. In 1899 the price of crude advanced at intervals from $1.40 to $1.68 per barrel, at which it closed the year. In 1900 the price continued advancing until $1.75 per barrel was reached, when a big strike in West Virginia so affected the general petroleum market that Canadian crude receded to $1.50, but an upward movement set in towards December, and the year ended with crude at $1.60 per barrel.

In round numbers, there are now about 10,000 wells yielding petroleum, all under the pump.

A deep well was sunk at Petrolea to about 3700 feet in depth. The hope was to strike oil in the Trenton f rmation, which was reached at about 3200 feet. After boring in the Trenton for about 300 feet without success the venture was abandoned. If the machinery had been equal to the task drilling would have been continued through the Trenton into the Archæan rocks, but it would have cost $1500 at the last squeeze to accomplish this, and the chance was not deemed worth the money. The Corniferous limestone therefore remains the only source of petroleum yet revealed in Ontario. Boring operations for petroleum have been undertaken by means of the Government "S" diamond drill near Ramsay's Corners in the county of Carleton. As yet no oil has been reached, but there was a strong flow of gas in both of the holes, at a depth of 413 feet in one, and at 130 and 555 feet in the other, when the drill was apparently in the Utica shales. The pressure in the second hole put down was estimated by the drill-runner at about 200 lbs. per inch. The diamond drill, whose boring capacity is about 500 feet, not being able to go farther down, it is proposed to put on a "plunger" plant and sink a deeper hole.

For a long time the town of Petrolea was the centre of the oil refining industry, but all refining is now done at Sarnia, where the Imperial Oil Company has extensive and very complete works. This company has a monopoly of the business in Ontario. Abundance of water and better shipping facilities are said to have brought about the change of location.

Natural Gas.

The value of the natural gas produced in the Province fell from $440,904 in 1899 to $392,823 in 1900, a diminution of 10 per cent. There were in operation 175 producing wells, requiring 306 miles of pipe for delivering the gas. Eleven new wells were put down during the year, of which seven proved productive. The number of workmen employed rose from 95 in 1899 to 161 in 1900, and wages of labor from $40,149 to $43,636.

Section 11 of 62 (2) Victoria, chapter 8 (Supplementary Revenue Act) imposes upon every company producing or transmitting natural gas in the Province an annual tax of $1500, and in addition a sum equal to one per cent. of the gross receipts during the preceding year. Under the provisions of this Act there were paid into the Treasury of the Province the following sums:

Interior Construction and Improvement Company	$1,875 40
Standard Oil and Gas Company of Essex, Limited	2,311 11
Natural Gas and Oil Company of Ontario, Limited	3,882 72
Provincial Natural Gas and Fuel Company of Ontario, Limited	2,490 72
Total	$10,559 95[2]

Upon the above basis, the gross value of the natural gas produced in Ontario in 1899 was $455,995, which was but little more than the value as given the Bureau's report for that year.

[2] Public Accounts Ont., 1900, p. xliii.

THE ESSEX FIELD

The two companies known respectively as the Natural Gas and Oil Company of Ontario, Limited, and the Standard Oil and Gas Company of Essex, Limited, have been merged under the management of the United Gas and Oil Company of Ontario, Limited, which latter corporation was organized in May, 1900. The output from the entire Essex county field exclusive of private wells and wells owned by municipalities in the vicinity of the field, amounted in the year 1900 to about three billion (3,000,000,000) cubic feet, representing the production from 52 wells. Four years ago the production of the field is stated to have been about 70,000,000 cubic feet per diem, or 25,550,000,000 cubic feet a year. The rock pressure has not materially diminished in the last two years, varying now between 325 and 350 lbs. per square inch. While the quantity of gas has been diminishing the number of consumers has increased during the past two years nearly 40 per cent., this increase being entirely in household consumption. Meantime the factory consumption has been lessening, due mainly to the circumstance that during severe cold weather the "pull" on the mains is so excessive that the supply is insufficient. The company affirms that this shortage is occasioned mainly by the insufficient pipe line capacity for delivering so large a volume as is required at these crises. The pressure in the field is reduced to 6 ozs. per sq. inch in the city mains.

There are at present 6 factories in Windsor and 5 in Walkerville using gas. Other factories which had been using gas have abandoned it in favor of coal, which can be obtained in Windsor at a maximum price of $2.00 per ton. Comparative boiler tests made at the Windsor Salt Works showed that, as the gas and coal were there burnt, using Clayborne burners for the gas and Jones automatic stokers for coal, the gas was worth but 6 cents to 7 cents per thousand cubic feet against slack coal of average quality at $2.00 per ton. The opinion of engineers in Detroit confirms this result, it being there stated that 30,000 cubic feet of the gas is the equivalent of 1 ton of average coal, which at $2.00 per ton would make 6.66 cents per thousand cubic feet for the gas. Coal in large lots, however, can be had in Detroit at $1.25 per ton. On this basis the ratio of cost between coal and gas would be as 1 to 3.12. As against this lies the fact that factories in Detroit are actually using gas at 13 cents per thousand, which is the regular factory price in that city, though some large consumers in 1900 were using gas under contract at 9 cents per thousand. Orr Brothers, in Windsor, who use the gas for steam raising at their flour mill, think that the gas is worth about 10 cents per thousand, though they are paying 13 cents. The gas company claims that the gas is worth 10 cents against slack coal at $2.00 per ton, judged by its evaporative power, but the cleanliness and freedom from expense in handling ashes, etc., make it still a desirable fuel at 13 cents.

All consumers are treated alike in Windsor, the only exception being the city electric light works and the waterworks, to each of which the gas is supplied at the same cost which they formerly incurred in burning coal. The rates in Windsor and Walkerville are 13 cents to factories, and for household uses 25 cents between the months of April and October, and 20 cents during the rest of the year. In Detroit the rates are 13 cents to factories and 28 cents to domestic consumers.

The quantity of gas now exported to Detroit is one and a half billion (1,500,000,000) cu ft. per annum, or one half of the output of the Essex county field. The exportation of gas to Toledo was discontinued in July, 1900.

The question as to the relative value of gas and coal when both are burned so as to secure the highest possible evaporative power, is on some accounts immaterial. It would seem at first sight that the gas could not be burned under the most favorable conditions when 30,000 cubic feet were required to equal 1 ton of coal. In the absence of recent analyses of the gas the relative value of the two fuels can not be accurately compared. It would appear that the gas

company is not doing as wisely as it might in supplying gas for factory consumption. In Welland county the gas is not supplied to any but domestic consumers, and the same rule is adhered to in Buffalo, where gas is piped from the Welland field, from fields near Buffalo, and from Pennsylvania.

The United Gas and Oil Co. have been making efforts to tap other gas reservoirs and to this end wells were bored by the company which they recently absorbed on Point Pelee, in the belief that they would thus be nearer an anticline assumed to be off the shore line toward Pelee Island. The result, however, was entirely disappointing. The company is now proposing to bore over a larger area in Welland county and to penetrate to the Trenton limestone. One well is being bored 2 miles east of Kingsville which has attained a depth of 1000 feet and will go to a depth of 1800 or 1900 feet.

THE WELLAND FIELD.

The Welland County field presents comparatively little change. The pressure is lowering very slowly, not more than a few pounds per year. At present it varies from 100 lbs. to 700 lbs. per square inch, the average of the larger number of wells being about 125 lbs. There are many however which yield gas under a pressure of 400 lbs., and one well which gives 700 lbs. This latter is used only at intervals, when necessary to maintain a uniform volume and pressure during periods of cold weather when the demand is heavy. Seventy-five wells are now connected to the pipe line, the total output being 700,000,000 cubic feet per annum, most of which is exported. In 1899 six wells were drilled in Willoughby township, some going to a depth of 900 feet, reaching the Medina formation. All of these were good wells, giving from 250 lbs. to 400 lbs. pressure per square inch. The gas pressure in the Welland field varies, as stated above, indicating that a number of separate reservoirs have been tapped. The average pressure of gas in the whole field has decreased about 60 per cent. since the beginning, but there is small reason to fear that the district will not be producing gas 15 years hence.

No gas pumps or compressors are used, the plant which was installed some years ago having been dismantled. All gas is now piped under normal rock pressure. Pumps are used however to exhaust water from the bottom of the wells so as to keep the rock drained for a considerable distance around each well, preventing the drowning out of the wells. After putting in these pumps the company was able to sell upwards of 3,000,000 cubic feet more gas *per diem*. In old wells the cost of the installation was from $500 to $600 per well, but in new wells it adds only about $250 to the cost. The pumps are operated by horse power, requiring from 15 to 40 minutes each day at each well. The quantity of water pumped out varies from half a barrel to several barrels from each well. Two men and one horse suffice for this service over the whole field, 62 wells being fitted with pumps.

As before stated, the Provincial Natural Gas and Fuel Company of Ontario, Ltd., which controls nearly the whole of the Welland field, does not supply a single factory either in Canada or in Buffalo. Gas is sold without discrimination to householders at the uniform rate of 27½ cents per thousand cubic feet, having been raised to this price from 25 cents two and a half years ago.

Natural gas has been used since 1892 in the town of Caledonia in Haldimand county, 6 wells being in operation. Three of these belong to the Caledonia Natural Gas Co., Ltd. The quantity of gas is diminishing rapidly, though the rock pressure still shows about 180 lbs. per square inch, a reduction of 10 lbs. since the first well was drilled. No effort has been made to determine the quantity of gas produced. Between 20 and 30 stores are regularly supplied. The gas is encountered at a depth of from 400 to 500 feet. One new well is being drilled at the present time, by Mr. W. H. Trotter.

For a long time opposition to the export of natural gas has been growing among the people of the county of Essex, who feared that the field was being depleted, and who naturally disliked to see large quantities taken from their own locality and sent to a foreign country while they themselves were at times experiencing great difficulty in having their own wants supplied. Application was made to the Ontario Government to terminate the license of occupation granted to the Interior Construction and Improvement Company dated 27 July, 1899, by virtue of which that company laid down a double pipe line across the bed of the Detroit river, and was thus enabled to carry the gas into Detroit and deliver it to consumers in that city. It was urged in support of this demand that no injustice would be done to the gas companies interested, as their product would find a ready sale on the Canadian side. The government on the recommendation of the Attorney-General passed an Order in Council on 13 April, 1901, directing the three months' notice of termination provided in the license to be given the company. Notice was served on the company accordingly on 19 April, 1900, to the effect that it was the intention of the Lieutenant-Governor in Council to revoke the said license of occupation in three months from that date unless good cause were shown to the contrary in the meantime.

A strike of gas is reported from lot 1 in the tenth concession of the township of Amabel, Bruce county, where the Trenton formation at a depth of 1,405 feet is said to have shown a gas pressure of 425 pounds to the inch. A company called the Grey and Bruce Oil and Gas Company has been organized with a capital of $100,000 to develop the field which is assumed to exist in the neighborhood of which the village of Hepworth is the centre.

Drilling has been going on in other parts of the province with the view of reaching the reservoirs of gas which are held to be comprised in the somewhat deeply seated Trenton rocks. Preparations are being made to bore at St. Mary's, Formosa and Peterborough.

Calcium Carbide.

The production of carbide of calcium last year amounted to 1,005 tons, valued at $60,300, which was somewhat less than in 1899. Two new manufactories were erected in Ottawa, but one of them was burned down in the great fire of April, and has not been rebuilt. The other, that of the Ottawa Carbide Company, Limited, has at present a capacity of 4,000 tons of carbide per year. The buildings however are erected suitable for the installation of furnaces which would bring up the capacity to 6 000 tons per year, and the plant is so arranged that additions may be made to increase the output to a total of 10,000 tons. The works are located on Victoria island, in that section of Ottawa known as the Chaudiére. The electric power is taken from the Ottawa Power Company. The engineer in charge of construction is Mr. Frank Creelman and the officers of the company are : president, Hon. E. H. Bronson ; vice-president, Thomas L. Willson ; secretary-treasurer, Levi Crannell ; manager, Frank Bronson. Operations were begun just about the close of the year.

The lime used in the manufacture of the carbide comes from Rockland, 38 miles from Ottawa, on the Canada Atlantic Railway. Analyses of the calcined limestone from the several benches in this quarry, yielding suitable material for these works, are as follows :—

	I.	II	III	IV.	V.
Lime (CaO.)	92.390	93.850	96 100	94.340	94.140
Magnesia (MgO.)	1.330	1 310	1.170	1.530	1.280
Sulphur	0 237	0.255	0.162	0 150	0.258
Phosphorus	0.009	0.008	0.003	0.004	0.009
Insoluble residue	6.031	4.577	2.565	3.976	4.313

The coke used comes entirely from the Reynoldsville district, Pennsylvania, being made from washed coal The works now contain twenty furnaces, requiring 200 h.p. per furnace. The plant also includes rolls and screens for grinding the coke. The power plant of the Ottawa Power Company contains two alternating current generators of 2,000-h.p. each, connected directly with Leffel turbine wheels.

The Willson Carbide Works Co. of St. Catharines, Limited, has in operation a similar plant at St. Catharines containing six furnaces each producing three and one-half tons of carbide per diem. The output for 1900 amounted to 1,005 tons calcium carbide. The principal stockholders of this company are Thomas L. Willson, St. Catharines, Ont., E. August Neresheimer, New York, Hon. James Sutherland, Woodstock, Ont., Sir William VanHorne, Montreal, William Mackenzie, Toronto, A. M. Scott, Wookstock, Ont., and William Gibson, Beamsville, Ont.

The possibilities of using charcoal or peat coke in place of ordinary coke do not appear to be favorable. The question is purely a commercial one. The peats available contain so large an amount of ash that the residue after charring holds an excessive quantity of earthy ingredients. The maximum amount of ash allowable in the carbonaceous material employed in the manufacture of calcium carbide is 10 per cent. To dispose of a larger amount of ash, by fluxing it off into the crust which surrounds the core of carbide in the charge at the end of the furnace treatment, would involve the expenditure of too much electric energy. The objection to the use of wood charcoal is that about 20 per cent. more by weight is required than when coke is used. This loss is occasioned by the blowing off of the charcoal dust with the carbon monoxide which is evolved in the chemical reactions that take place in the formation of the carbide. This dust is consumed in the air along with the carbon monoxide, and is consequently lost. It may also be observed that it has been found that 48-hour bee-hive coke is superior for this manufacture to coke which has been 72 hours in the oven.

ACETYLENE AND CARBIDE IN GERMANY.

A British blue book (No. 540 Miscellaneous Series, November, 1900,) reviews the present position of acetylene and calcium carbide in Germany, pointing out that "one of the most remarkable instances of the creation and rapid growth of an entirely new industry has been seen in Germany during the last four years, in the manufacture of calcium carbide and the progress of acetylene gas lighting." Up to July, 1898, 62,000 jets of acetylene were installed in that country; in the first months of 1899 the number had increased to 170,000, and at the end of that year, assuming the rate of progress to have been maintained, it was about 220,000. Taking the illuminating power of the acetylene flame at 40 normal candle-power, this would give a total of 8,800,000 candles, without reckoning the large number of jets used in burning the acetylene oil-gas mixture employed so extensively by the German railways. The obstacles encountered in the utilization of the gas, and experimentation for the purpose of finding the best methods of generating and burning it, have stimulated German invention to a high degree, 617 patents being applied for in 1897 and 937 in 1898, no other branch of industry in Germany showing such a large and steady increase in the number of patents. On the other hand, inventions for other illuminants are gradually decreasing; in 1895, 304 patents were granted, in 1897, 288, and in 1898, 209.

The results of German experience, after a period of trial and uncertainty, show that acetylene gas generators must be built of strong and durable materials, and that the method of generation must above all things exclude undue pressure and heating of the gas. For large installations of above 1,000 jets the system of generation "carbide into water" is almost universally in use. The system of flooding carbide by water still holds its own in suitably constructed apparatus, especially when some cooling arrangement is provided, but the general trend of scientific opinion in Germany amongst acetylene chemists and engineers, is all in favor of dropping the carbide into water.

The thorough purification of acetylene is considered to be of equal importance to the suitable construction of the generators. The impurities, chief among which are the compounds of phosphorus, are removed by the use of various substances, such as chloride of lime, a solution of chromic acid in acetic or sulphuric acid, etc. Several new uses both of the carbide and the acetylene have been discovered, among others the employment of the former as a reducing agent

to separate metals such as copper and lead from their ores, as well as in the making of converted steel and the hardening of armor-plate after Harvey's process ; the production of lamp-black from acetylene, the use of the latter in driving gas-engines and motor-cars, etc.

Acetylene bids fair to become a successful rival in Germany to petroleum, now the chief illuminant, which is almost entirely imported. Supplies of carbide are also in the main brought in from foreign countries, principally Switzerland, Austria, Sweden, Italy and France. Formerly a good deal came from the United States, but now none is sent. There is a comparative scarcity of water-power in Germany, and hence the waste gases from blast furnaces have been utilized in the manufacture of carbide as well as in the working of gas engines.

The prejudice against the use of acetylene which was rife at the beginning, has almost entirely disappeared. Experience has shown that its use for lighting or other purposes involves no more danger than the use of coal gas or petroleum. Insurance companies have decided, if certain simple precautions are observed, not to exact any additional premiums on the rates for insurance of buildings lit by acetylene. A comparison of the cost of lighting by acetylene with that by petroleum, coal gas and electricity, shows that it is about equal to petroleum, less than coal gas in open burner but greater than incandescent coal gas, and half the cost of electricity. On the railways of Germany the lighting of trains by pure acetylene in a compressed form has largely given place to illumination by a mixture of oil-gas and acetylene in the proportion of about 75 parts of the former to 25 of the latter, this mixture having three times the lighting power of oil-gas and being free from the explosive properties of compressed acetylene. Moreover, the c st by the improved method is only one-half that by oil-gas and no more than by acetylene.

A notable feature of the calcuim carbide industry in Europe last year was the heavy fall in price, due to over-production. At the beginning of the year carbide was selling at £15 to £20 per ton at the various places of manufacture on the continent ; six months later it could be procured f.o.b. at Hamburg or Rotterdam for £10 10s. per ton including packages. At this price most of the factories were unable to make any profit, and many of them closed for an indefinite period, while some turned their attention to other electro-chemical industries. It is considered probable that the future price of carbide will not rise above £12 per ton In Great Britain the manufacture of carbide is chiefly in the hands of the British Aluminium Company, who can produce if required 3,000 tons per annum at Foyers, while the United Alkali Company have recently commenced to produce it in Lancashire.[3]

Salt and Gypsum

Ten works were evaporating brine into salt in the western part of the peninsula last year, their total output being 66,588 tons of fine and coarse worth $324,477. The production was 10,213 tons in weight and $7,065 in value more than in 1899. Prices were a little steadier last year, but salt manufacturers complain that the heavy freight on th ir fuel—slack coal—due to the long railway haul, is a serious drawback to their business, and places a difficulty in the way of realizing profits.

There are abundant supplies of gypsum in the valley of the Grand River, but only a small trade is done in putting it on the market. The product was a little less in bulk and a little more in value that in the year before.

Gypsum, or "plaster" as it is locally termed, has been produced irregularly in the vicinity of Caledonia since 1874. In that year a mine was opened by Nicholas Garland about two and a half miles southeast of Caledonia, which has since been abandoned. In 1886 a new mine was opened about a half a mile east of this by Mr. Garland, which was continuously operated for nine years. In 1898 the property was acquired by William Smith of Caledonia, who operated it until May, 1900. Work was resumed in September, 1900, and has been continued since. The

3 Imperial Institute Journal, April 1901, p. 97.

mine is located on the west half of lot 14, in the fifth concession of Oneida, Haldimand county. The deposit lies at an average depth of 70 feet below the surface, and is reached by an incline 270 feet in length. The tunnel continues south southeast 40 feet, at which point a drift turns southwest 245 feet.

The working face in the gypsum bed lies along a portion of this drift, so that the drift follows the advancing face, rendering the method of mining analogous to that known as "long wall." The drift is 4 feet 8 inches wide inside timbers, and 5 feet 9 inches high in the clear. The posts and caps consist of timbers 6 inches square, and in the incline full sets including sills are used. Lagging above sets is used throughout. There may be some question as to the safety of the mine, though new timbers are inserted whenever signs of danger appear from excessive flexure of the lagging. Only two to three men are employed underground. The gypsum is shipped to the Alabastine Company, Paris, Ont., for grinding. This is the only mine in the Province at present producing white gypsum.

Talc, Graphite and Mica

Talc of good quality is being produced from a mine near Madoc, 1,000 tons having been raised in 1900, all of which went to New York and, it is stated, was distributed mainly as samples throughout the United States and part of Europe in competition with the fine French and Italian talcs. If the manufacture of paper takes vigorous root in Ontario, as there is every likelihood of its doing, there will probably arise a demand for talc to be used as a "filler," for which purpose it is in high repute in the United States. There is a prospect of a mill being established for grinding the talc at or near the mine.

The Black Donald graphite mine was worked with some vigor during the year, 1802 tons of graphite having been mined. Owing to distance from the railway the product can only be got to market during the winter.

This deposit, which is of unusual size as compared with most American veins of the substance, has been undergoing development at a point 12 miles west (22 miles by waggon road) of Calabogie station on the Kingston and Pembroke railroad. The company was organized in 1896 with a capital stock of $200,000, the directors being G. P. Brophy, J. B. Brophy, S. H. Fleming, J. W. McRae, and Hector McRae. The offices of the company are at 58 Queen street, Ottawa. The mine is in the township of Brougham, Renfrew county, lots 16, 17, 18 and 19 in the third concession. The workings consist of open cuts and a shaft 80 feet deep, from the bottom of which a drift on the vein extends 150 feet northeast, going under Whitefish lake. The vein stands vertically, and at a depth of 80 feet measures 22 feet in width. The enclosing country rock on both walls is limestone. Hoisting is still done with a derrick and a two-ton hoisting engine. A permanent three-compartment shaft is contemplated which will be suitably equipped with modern hoisting appliances. The mine is kept unwatered with two mine pumps actuated by compressed air. A three-drill Ingersoll air compressor provides air for the pumps and for rock drills. Steam is generated by two boilers, locomotive type, of 45-h.p. each. The buildings on the property consist of a boiler and power house, a storage house 30 feet by 50 feet, and a boarding and sleeping camp. Since opening the mines 4,000 tons of graphite have been shipped, of which 1,300 tons represent the output for 1900.

An analysis of this graphite, made by the Crescent Steel Company in 1899 shows the following composition :

Silica	3.90	per cent.
Ferric oxide	.70	"
Alumina	.05	"
Lime (CaO)	10 05	"
Magnesia (MgO)	1.00	"
Graphitic carbon	84.06	"
Moisture	.32	"
	100.08	

The company purpose putting up a plant for manufacturing the product, as they are convinced their business can in this way be rendered much more profitable. A shaft composed of large blocks of graphite from the Black Donald mine will be one of the features of the Ontario exhibit of minerals at the Pan-American Exposition, Buffalo.

Mica is one of the minerals whose published production is almost certainly less than the real output. The yield of Ontario mines for 1900, according to returns made to the Bureau, was 643 tons, valued at $91,750, as compared with 266 tons worth $38,000 in 1899, being an increase of 141 per cent. More than one cause operates to depress the apparent yield. In the first place, many of the producers work intermittently and in a small way, digging up the mica which outcrops on their own farms and desisting when prices fall or when the pockets are exhausted ; thus making it difficult to compile a complete list of persons taking out mica in any one year or to procure a full return. In the second place, the product very largely seeks a foreign market, which has hitherto been that of the United States, and apprehension of tariff difficulties and agitations doubtless has an effect in keeping down the statistics of production. During the earlier part of the year the demand from across the line for Canadian mica was good, and prices were satisfactory, but towards its close those engaged in the production allege a determined effort was made to "bear" the price, and a somewhat general withdrawal from the market was arranged among the purchasers, the result being less activity in the trade. The exports of Canadian mica, which means the product of Quebec and Ontario mines, for the twelve months ending 30th June, 1900, according to the report of the Department of Trade and Commerce were 1,078,752 lbs., worth $136,332, practically the whole of which went to the United States. The wants of British manufacturers of electrical machinery and other articles requiring mica are almost wholly supplied from the mines of Bengal and Madras, though there is reason to believe that the Indian product is somewhat inferior to the Canadian in quality.

Scrap or waste mica continues in good demand for the fabrication of boiler-pipe covering. The Mica Boiler Covering Company whose factory was originally established at Toronto a few years ago but is now situated at Montreal, is producing an article which finds much acceptance among the users of boilers and steam pipes for the purpose of preventing the radiation of heat and consequent waste of fuel. A second factory has been established in England ; a third is in contemplation in the United States, and a fourth will probably be built in India, where large stores of otherwise useless mica have accumulated at the mines. The battleship Drake lately launched by the British Admiralty is fitted throughout with mica boiler covering.

Corundum and Felspar.

For the first time corundum and felspar appear in the list of the mineral products of Ontario. The very extensive deposits of corundum which were brought to light two or three years ago are being exploited by several companies with the view of supplying the market with abrasive material and goods of a high grade of excellence. The first of these companies to be organized was the Canada Corundum Company, which in addition to lands purchased from private owners obtained leases from the Crown covering a number of lots in the townships of Raglan Carlow, Brudenel, Dungannon and Monteagle, containing in all about 1,000 acres. The conditions of the concession, which was dated the 15th day of September, 1899 and made between the Government of the first part and Messrs. Joseph H. Shenstone and B. A. C. Craig of the second part, required the expenditure of $100,000 in the development of the lands and the establishment of a corundum industry.

Substantial progress has been made by the company which was formed to operate under the contract with the Government. A mill has been erected in the township of Raglan, about seven miles distant from the village of Combermere, and the various problems which arose in the treatment of a hitherto untried material have been vigorously attacked and it is claimed success-

fully solved. The company's intention is to replace this experimental plant by a larger and more substantial mill thoroughly equipped with machinery for separating the corundum from its matrix, crushing and sizing it. About 60 tons of sized corundum grains were produced before the close of 1900, and a large number of wheels have been manufactured therefrom. The testimony from the users of the wheels is unanimous as to their excellent quality and the amount of grinding they will accomplish in comparison with other wheels now being sold for similar purposes whether made of emery, corundum from other sources, or other abrasive material. The extent and richness of the corundum deposits, which carry as high as 30 per cent ore, and the satisfactory results obtained in foundries and machine shops from wheels made of the product, afford the best of ground for believing that this Province among its other unique mineral advantages possesses that of owning the largest and best corundum fields which have yet been discovered anywhere.

The Crown Corundum Company, Limited, has been organized to work lands carrying corundum, mica and felspar in the townships of Methuen and Burleigh, Peterborough county. The authorized capital is $1,000,000 in 1,000,000 shares of $1 each. President, Wallace C. Keith, M. D., Boston, Mass.; managing director, James Curry, financial broker, Manning Arcade, Toronto.

One or two other parties are also interesting themselves in the corundum business, and the prospects are good for the development of a considerable industry on the basis of Ontario corundum.

A very large deposit of felspar (orthoclase) has been worked since 14 December, 1900, by Messrs. H. Richardson and George Smith of Kingston, on lot 1 in the second concession of Bedford, Frontenac county. The property is owned by Mr. Aaron Hoppins, and is situated 4 miles east of Bedford Station on the Kingston and Pembroke railway, between Desert and Thirteen Islands Lakes. There are two separate bodies of the felspar separated by a narrow band of white quartz rock. The deposit which is being operated is 150 feet wide, and has been traced along the outcrop 225 feet. The other deposit is 60 feet wide and shows on the surface for a distance of 300 feet. The output to March 1st has been 4,000 tons, all of which has been exported to Trenton, New Jersey, for use in the manufacture of pottery. Two analyses of this felspar are appended, No. 1 having been made at Kingston, and No. 2 by Heinrich Reis, Ph.D. of Cornell University :—

	No. 1.	No. 2.
Silica	66 23 per cent.	65 40 per cent.
Alumina	18.77 "	18.80 "
Ferric oxide	trace	trace.
Potash	12.09 "	13.90 "
Soda	3.11 "	1.95 "
Lime	0.31 "	nil.
Magnesia	nil.	nil.
Loss on ignition	nil.	0.60 "
	100 51 per cent.	100.65 per cent.

Iron Ore and Pig Iron.

The number of iron mines working in the Province last year was 12, the total product of which was 90,302 tons of ore valued at the pit's mouth at $111,805, the increase over 1899 being 73,391 tons in quantity and $80,854 in value. The number of workmen employed at the mines was 438 whose wage bill for the year amounted to $107,583, as against 100 men in 1899 earning wages of $26,700. A large part of this marked increase is due to the opening of the great

Helen mine in the Michipicoton Mining Division, a deposit whose importance and bearing upon the development of the iron business of the Province is so great that it may be said to have wrought an entire change in the situation since its discovery. Of the total quantity of ore mined, 16,850 tons were magnetite and 73,452 tons hematite.

The iron industry has long been recognized as lying at the base of the material welfare of industrial communities, and almost alone among the commonwealths that make up the northern half of this continent the Province of Ontario remained for years without raising a pound of iron ore or smelting a ton of pig iron This was not because nature had denied her the raw materials for the industry. On the contrary, her supplies of iron ore were long ago found to be extensive, and her forests of hardwood provided the very best of charcoal. Early in the history of the Province attempts were made, not without success, to operate blast furnaces on native ores, but from various causes the smelting industry became fitful and intermittent, and finally ceased to exist. The mining of ore for export to the United States survived for a number of years but a hostile tariff and the discovery of the more cheaply won ores of the Lake Superior region put an end even to this branch of the business, and deep sleep settled upon the iron mines of Ontario.

In 1895 some energetic and far-sighted men recognizing that a progressive community like Ontario furnished a home market for iron such as was hardly found elsewhere, established a blast furnace in the city of Hamilton having a capacity of 200 tons of pig iron per day. The furnace was a success from the start, and the company controlling it during 1900 added a plant for the manufacture of steel by the open hearth process, capable of making 80 to 90 tons a day.

The Hamilton Blast Furnace Company's example was followed in 1899 by the Deseronto Iron Company, which preferred to make charcoal iron, and whose decision to build a furnace in Ontario was in part due to a provision of the United States tariff that certainly was not intended to encourage the growth of manufactures in Canada. Large quantities of charcoal made at Deseronto were exported to Detroit for use in iron furnaces in that city, and with the desire of affording protection to the charcoal burners of the United States and of checking the imports of charcoal into that country, the tariff was amended to bear more heavily on that article. The somewhat unexpected result was to plant the charcoal iron business in Ontario, where unlimited supplies of wood were available, and where other conditions were almost as favorable as in Michigan. The charcoal business of Deseronto was not destroyed, but continued to flourish, and found its complement in the new industry for the making of charcoal iron of a superior quality.

Both these furnaces had the advantage of being blown in before the remarkable expansion of the iron industry began in 1899, accompanied as it was by an almost unprecedented increase in the price of pig iron, which doubled itself within a year.

The Canada Iron Furnace Company, Limited, already carrying on a long-established and successful business at Radnor Forges in the Province of Quebec, next entered the field and erected a smelter at the town of Midland on the Georgian Bay. A short description of the Midland smelter was given in the Bureau's report for last year, but the importance of the plant merits for it a more detailed account.

THE MIDLAND BLAST FURNACE.

The Canada Iron Furnace Company's new blast furnace plant at Midland, Ont., is situated on the shore of Midland bay, immediately opposite the town, with a perfectly sheltered harbor safe at all seasons of the year. The property on which the plant is built is about 100 acres in extent, with a splendid water front on the bay, the works being erected in immediate proximity to the water. The furnace water front will be available for vessels of the largest size.

The furnace is of the usual type constructed of steel. Its height is 64 feet and the diameter ıt the bosh 13 feet. Its capacity in 24 hours is 150 gross tons of iron. The bosh and crucible ıre protected by a Russell Wheel and Foundry Company water jacket. All the fittings of the 'urnace are of the most modern description.

The hoist tower is constructed of cast iron columns, resting on a solid concrete foundation. The whole is sheeted with corrugated, galvanized iron, and is practically indestructible. Besides the sections devoted to the elevator cages there is a third fitted up with stairs to enable he workmen to ascend and descend without using the elevator. The top of the tower is fitted vith safety floors and other devices for the purpose of protecting the men from accident. The ıoist engine, which operates the elevators, is of the well-known Crane type, double cylinder, ize 10 by 12 feet, and is erected on a solid concrete foundation capped with a block of ranite.

There are three fire-brick stoves of the "two-pass" type, 16 feet in diameter and 60 feet ıigh. The whole is provided with a complete outfit of modern valves, etc., and is erected on a olid concrete foundation, faced with granite, the size at top being 60 feet 2 inches by 27 feet ! inches. The stoves are capable of heating up to 1,400 deg. Fahr.

There are two blowing engines manufactured by the Columbus Machine Company of Columbus, Ohio. They are of the vertical type, each with 34-inch steam cylinders and 48-inch troke. The air cylinders are 6 feet in diameter, and each engine is capable of blowing 10,000 ubic feet of air per minute, or sufficient blast for the furnace. The engines are thoroughly vell finished and fitted out with all requirements, including patent water heaters for boiler feed.

There are eight boilers of the flue type, 52 inches in diameter and 28 feet long, each having ! eighteen-inch flues. The boilers are in batteries of two each, three batteries being sufficient o supply all the steam required, leaving two boilers in reserve so that the plant can always be ept in a state of thorough repair and efficiency. The shells are double rivetted and the steam ressure is 90 lbs. The boilers are heated by waste gas from the furnace, but are so arranged hat wood or coal can be used if necessary.

There are two Gordon duplex, outside packing pumps 16 inches by 10 inches by 12 inches, ısed for furnace and stove circulation and also for fire purposes. There is also a Gordon luplex, outside packing pump 8 inches by 5 inches by 6 inches which is used for boiler feed urposes. All pumps are more than ample for requirements. They feed from a concrete istern, 12 feet diameter at top, 6 feet diameter at bottom and 10 feet deep. This cistern is n the cellar of the engine house and is 6 feet below the level of the bay, with which it has ommunication by means of a heavy 20 by 20-inch wooden intake pipe and a 23-inch iron pipe 0 feet outside of the building. This pipe can be closed in the cistern by means of a valve. Vith this cistern freezing of suction pipes in the winter is impossible.

The chimney is constructed of steel, is 8 feet 6 inches in diameter, 174 feet high, and is rected on a massive square base of concrete faced with granite. The base is 26 feet square at he bottom and 20 feet at the top and stands 21 feet high. The chimney is lined with fire-brick nd serves both boilers and hot blast stoves.

The water tank is situated on a hill at the rear of the furnace. It is cylindrical in shape, 2 feet diameter and 40 feet high, and is made of steel plate, double rivetted. The tank is rected on a solid concrete foundation, faced with granite, and is 72 feet above the level of the ay. Its capacity is 28,000 gallons.

MACHINERY AND EQUIPMENT.

There are two crushers, one a Gates No. 5 gyratory machine, capable of crushing about 00 tons per hour, driven by a Jenckes Machine Company boiler and engine of 25-h.p. capacity; nd one 10-inch Blake stone crusher, capable of crushing about 25 tons per hour.

The scale equipment consists of one sixty-ton railway track scale made by the Rome Scale Company, one five-beam Howe scale for stock weighing, one Howe scale for weighing pig iron from cast house and two one ton steelyard scales for weighing pig iron from yard to cars.

A modern electric light plant, with a 25-kilowatt dynamo directed to a 9 by 10-inch engine, manufactured by the Canadian General Electric Company, is now being installed, which will thoroughly light up all the buildings and the yard of the company. This plant will have a capacity of 25 arc and 200 incandescent lamps.

An ore discharging plant will be put in at an early day and will be up-to-date in every particular. As the water at the wharf front is 22 feet deep, large vessels can be handled speedily and economically.

The cast house is a brick structure 40 feet by 165 feet and 21 feet 6 inches high. The trusses near the furnace are of steel, and the balance of wood covered by asbestos. The wooden roof is covered with Sparham fire-proof cement. The walls are entirely of brick, with heavy pilasters, erected on a solid concrete foundation faced with granite. The floor level is 5 feet above the yard level and the whole bottom is properly drained. In this building there is an overhead trolley system for the purpose of facilitating the removal of pig iron.

The engine house is also of brick and is 40 feet by 67 feet 6 inches, and 48 feet high, with heavy pilasters erected on a concrete foundation faced with granite. The cellar is excavated and floored heavily with concrete. The roof is double, of wood covered with Sparham fire-proof cement, and is supported by wooden trusses. The building is provided with an overhead travelling crane of 12 tons capacity, capable of handling any part of the machinery.

The boiler house is built with iron columns which carry the steel trusses supporting the roof. Between the columns is brick work, heavily pilastered and erected on a concrete foundation faced with granite. The roof is wooden and is covered with Sparham fire-proof cement. The boiler house adjoins the engine house, and the boilers all face the latter, leaving the whole at all times under the engineer's eye.

The machine shop is a brick building 30 feet by 60 feet, 11 feet 6 inches high, erected on a concrete foundation faced with granite. In this building is a complete blacksmith shop, with tools, a carpenter shop with modern wood-working machinery, a fully equipped machine shop, a 20-h.p. steam boiler and engine, shafting, pulleys and a steam pump. An ore sample grinder and a sawing machine for cutting samples of iron are also in this building.

At present the officials of the company at the works occupy temporary offices, but it is the intention during the coming season to build general offices in keeping with the works, which will contain public and private offices, directors' board room, drawing office, etc.

The laboratory is now situated in the temporary office building, but a new laboratory building 30 feet by 40 feet is being erected. This will be of brick and in keeping with the other buildings. It will be fully equipped and up-to-date in every way. The staff consists of three chemists.

FACILITIES FOR HANDLING FREIGHT.

The company's water front has an extent of about 1,700 feet and the wharves already built are of the most substantial kind.

The iron yard is so situated that it is reached by four railway sidings, thus ensuring rapid and economical handling of iron. From the yard the wharf can be reached by tram cars.

The company's limestone quarry is situated on the opposite side of the bay about two miles from the works. It contains 138 acres on the shore of the bay, with a gradual rise from

the water's edge, which will allow trams to be delivered from the quarry to the wharf by gravity. The entire 138 acres is a ridge of limestone with only a light covering of earth in places.

The company's steam yacht "Voyageur" is a modern steel craft 67 feet 6 inches long, 12 feet beam and 5 feet 6 inches hold. The entire hull, decks, forward bulkhead, etc., are of steel. She is of light draft and fast. The entire bottom of the hull is sheathed with rock elm, making her exceedingly well adapted for exploring the shallow, rocky bays along the coast. She is full cabined and fitted to accommodate 15 guests, with sleeping quarters, etc., and is provided with a kitchen and dining-room. This steamer is also used for towing.

The grounds around the works are fitted out with railway switches so that raw material as well as pig iron can be handled with the utmost economy. The company owns and controls these sidings, which connect with the Grand Trunk Railway at the edge of the furnace property.

The entire plant is laid out with a view to obtaining the utmost economy in the assembling of raw materials, the delivery of same to the furnace, and the handling of waste material and finished iron, and also with a view to economizing labor in the operation of the plant.

A vessel discharging ore at the wharf delivers it on the stock-ground immediately in the rear of the furnace elevator. From this pile it is handled to furnace barrows and thence charged into the furnace.

The pig iron is delivered from the front of the cast house on the weighing and grading platform, and thence it can be delivered direct to railway cars or to trams for conveyance to the wharves or to piles in the yard.

The slag can either be delivered into a slag car or be allowed to spread over the ground and broken up for the purpose of grading up grounds, building wharves etc. It is run from the furnace at a point most convenient for these purposes.

The following are the names of the directors of the company: P. H. Griffin, Hon. P. Guildford Smith, Buffalo, N. Y.; Geo. E. Drummond, T. J. Drummond, J. T. McCall and A. F. Gault, Montreal, P.Q.; Geo. Gudewill, New York, N.Y.; F. H. Clergue, Sault Ste. Marie, Ont.; and E. V. Douglas, Philadelphia, Pa.

The officers are: P. H. Griffin, President; Hon. T. Guildford Smith, Vice-President; Geo. E. Drummond, Managing Director and Treasurer; T. J. Drummond, Secretary; and Jno. J. Drummond, General Superintendent.

The authorized capital of the company is $1,000,000 in 10,000 shares of $100 each. The subscribed and paid up capital is $500 000, and the company have an issue of $200,000 of 5 per cent. 20-year gold bonds.

The fires in the Midland furnace were first lighted on 28 November, 1900, by Mr. George Gudewill of New York, one of the directors of the company, since which time the plant has been running steadily with a force of about two hundred hands.

The Company's original intention was to manufacture charcoal iron in Ontario as they were already doing in Quebec, but when ready to begin operations the demand for labor was so great as to render it impossible to get workmen to provide cordwood. At the same time cordwood lands in the neighborhood took on an inflated value, and there being no available Crown territory from which a supply of wood could be procured, the Company was obliged to begin by using coke. This fuel is still in use, but the idea of making charcoal iron has not been abandoned.

At the beginning of the campaign various American ores were tested along with 60 or 70 per cent. of ore from the Helen mine, Michipicoton, with the view of ascertaining whether a mixture would be desirable. Experience proved in favor of Helen ore unmixed with any other, and the furnace has now been running for some time on this ore alone with great satisfaction.

GROWTH OF THE IRON INDUSTRY.

In the following table are given figures showing the progress of the pig iron industry during the past five years :

	1896	1897	1898	1899	1900	Totals
Ore smelted.... tons	51,138	37,492	77,023	110,036	100,692	376,381
Scale and mill cinder .... "	5,883	5,350	8,614	10,004	13,092	42,943
Limestone for flux.... "	8,657	9,473	13,799	25,301	24,927	82,157
Coke for fuel.... "	30,348	27,810	50,407	74,403	59,345	242,313
Charcoal for fuel.... bush.	....	....	....	....	955,437	4
Pig iron product.... tons	28,302	24,011	48,253	64,749	62,386	227,701
Steel product .... "	....	....	....	....	2,819	2,819
Value of pig iron product.... $	353,780	288,128	530,789	808,157	936,066	2,916,920
Wages for labor.... "	47,000	40,000	61,476	79,869	97,9 5	326,260
Average workmen.... No.	125	130	130	200	419	.. ..

Statistics of charcoal collected for 1900 only.

The total quantity of pig iron produced during the year was 9,344 tons less than in 1899, but there was again an advance in the value per ton, the average price rising from $12.48 in 1899 to $15.00 in 1900. The total value of the pig product in 1900 was therefore $127,909 more than in 1899. Steel figures in the returns for the first time, 2,819 tons of the open hearth variety having been produced at Hamilton, worth $46,380.

Ores raised from mines in Ontario were smelted to the extent of 22,887 tons, or 23 per cent. of the whole, the remainder being ore imported from the United States, mostly from the Lake Superior district. It is in every way likely now that an abundant supply of good hematite has been uncovered in the Michipicoton district which can be freely drawn on for the use of Ontario furnaces that the proportion of native ores smelted during 1901 and succeeding years will be much greater than heretofore.

There were 200 workmen returned as employed at the blast furnaces of the Province in 1899 earning aggregate wages of $79,869 ; in 1900 the average number was 419 and the wages paid $97,915. From the latter amount is excluded wages paid for construction work on the new furnace at Midland. In the iron mines themselves 439 men found employment whose aggregate earnings were $107,583. This is nearly as large a sum as the value of the iron ore produced, but in it is included a considerable amount expended in opening up the Helen and other mines and placing them in a position to begin shipments.

AID BY GOVERNMENT BOUNTIES.

Both the Legislature of Ontario and the Parliament of Canada have deemed it in the public interest to encourage the iron industry by special legislation, of which it may be well to give the particulars here. In both cases the assistance has taken the form of a bounty payable out of the general revenue, the Province choosing to extend a helping hand to the miner of the ore, while the Dominion grant is payable to the company producing the pig iron, puddled bars or steel, as the case may be. In addition to this direct aid, the tariff of Canada imposes a duty of $2.50 per ton on pig iron and $2 per ton on iron or steel ingots, puddled bars, etc.

Provincial aid to iron mining is governed by the Mines Act, R.S.O., 1897, chapter 36, which provides a fund of $125,000 called the Iron Mining Fund, out of which there may be paid to the producers or miners of iron ore raised and smelted in Ontario a bounty at the rate of one dollar per ton of the pig metal product of the ore The period of the bounty extends to 1 January, 1906, but there is a limitation to the effect that not more than $25,000 shall be paid out in any one year, and if the quantity of ore mined and smelted in any year exceeds the

equivalent of 25,000 tons of pig iron, the bounty shall be proportionately reduced. So far the maximum figure per annum has not been reached, but the probability is that in 1901 the production of pig iron from native ore will be large enough to lower the bounty rate materially.

The production of pig iron from Ontario ores and the amounts paid out of the Iron Mining Fund since its establishment have been as follows, it being understood that under the regulations framed in pursuance of the Act the bounty year ends 31 October annually, and that aid is given only in respect of ore raised subsequently to 1 January, 1896, and actually smelted into pig iron in the Province :—

PAYMENTS FROM IRON MINING FUND.

Year.	Tons pig iron.	Bounty.
		$
1896	4,000 00	4,000 00
1897	2,603.95	2,603 95
1898	8,647.19	8,647 19
1899	12,752 07	12,752 07
1900	6,737.80	6,737 80
Totals	34,741.01	$34,741 01

The assistance which is extended to the iron industry by the Dominion Government is given to the producers of pig iron, puddled bars and steel ingots. Chapter 6 of 60-61 Victoria (1897), Statutes of Canada, provided bounties as follows : on steel ingots manufactured from ingredients of which not less than 50 per cent. of the weight thereof consists of pig iron made in Canada, $3 per ton ; on puddled iron bars manufactured from pig iron made in Canada, $3 per ton ; and on pig iron manufactured from ore $3 per ton on the proportion produced from Canadian ore,and $2 per ton on the proportion produced from foreign ore. The period for the payment of the bounties was to end 23 April, 1902.

Chapter 8 of 62-63 Victoria, Statutes of Canada, extended the bounty period to 30 June, 1907, and enacted a sliding scale as follows, looking to the gradual extinguishment of governmental aid : up to 23 April, 1902, the rates were to be as fixed by the Act of 1897 ; from 23 April, 1902, to 30 June, 1903, 90 per cent. of those rates ; from 1 July, 1903, to 30 June, 1904, 75 per cent. ; from 1 July, 1904, to 30 June, 1905, 55 per cent. ; from 1 July, 1905, to 30 June, 1906, 35 per cent. ; and from 1 July, 1906, to 30 June, 1907, 20 per cent. By this Act it was further provided that no bounty should be paid on steel ingots made from puddled iron bars manufactured in Canada.

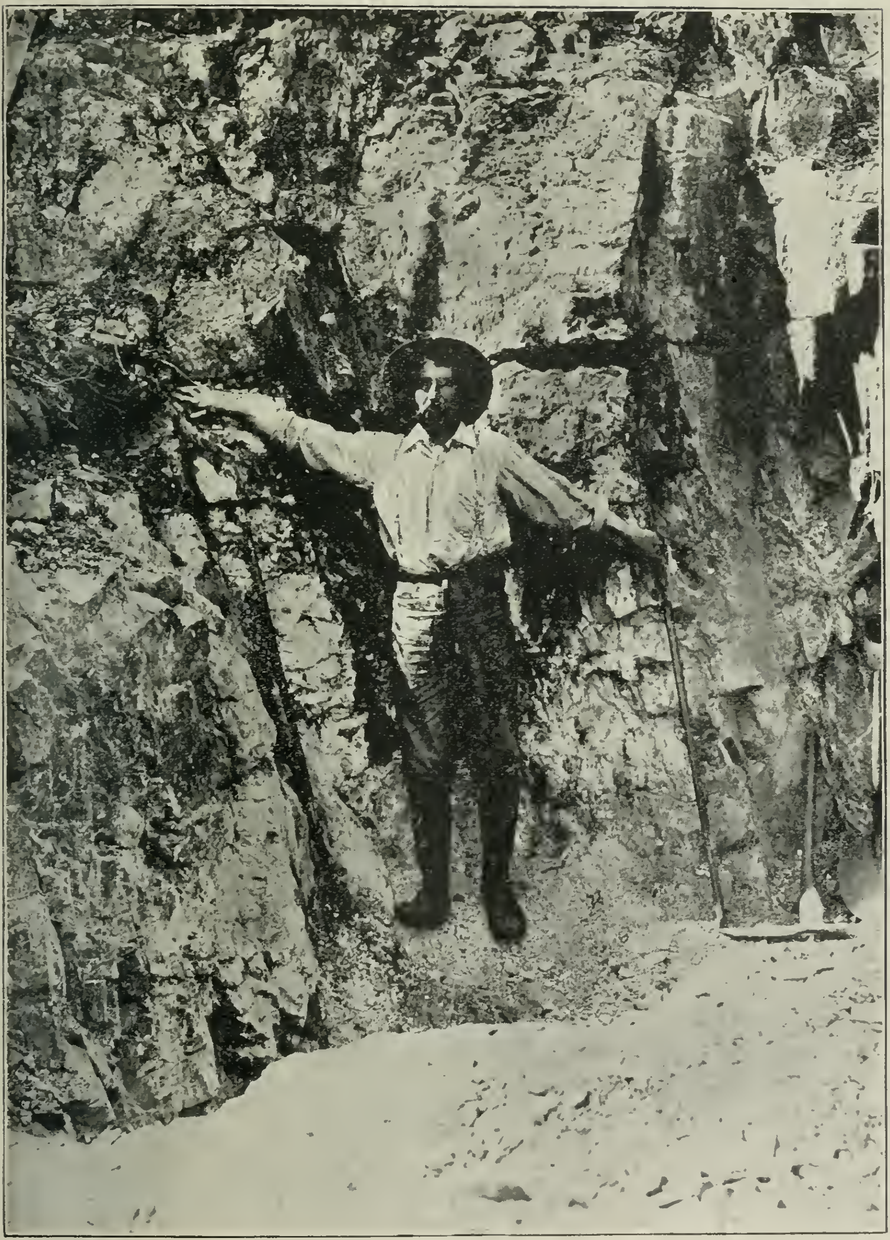
It may be interesting to note the extent to which the aid provided by the Dominion Government is being availed of. During the fiscal year ending 30 June, 1900, payments were made on account of the bounties as follows :

BOUNTY ON PIG IRON.

Name of company.	Pig iron from Canadian ore.	Pig iron from foreign ore.	Bounty on pig iron from Canadian ore.	Bounty on pig iron from foreign ore.	Total bounty.
	tons.	tons.	$	$	$
Canada Iron Furnace Coy	6,052.78	38.29	18,158 34	76 58	18,234 92
Deseronto Iron Coy	462.00	12,820.00	1,386 00	25,640 00	27,026 00
Hamilton Blast Furnace Coy	11,929.19	35,611.06	35,787 57	71,222 12	107,009 69
John McDougall & Coy	1,828.37	....	5,485 07	... .	5,485 07
Nova Scotia Steel Coy	11,886.22	18,751.77	35,658 67	37,503 55	73,162 22
Mineral Products Coy, Pictou, N. S.	2,459.41	....	7,378 24	....	7,378 24
Totals	34,617.97	67,221.12	$103,853 89	$134,442 25	$238,296 14

Stamp Mill at Hammond Reef Gold Mine.

Quartz Outcrop Elizabeth Mine, Anglo-Canadian Gold Estates.



[4] Quartz Outcrop Reliance Mine, Anglo-Canadian Gold Estates.

The following amounts were paid as bounty on puddled iron bars and steel ingots :

BOUNTY ON PUDDLED BARS AND STEEL.

Name of company.	Puddled bars made. tons.	Steel ingots made. tons.	Bounty on puddled bars. $	Bounty on steel ingots. $	Total bounty. $
Ontario Rolling Mills Co..............	300.16	....	1,200 50	....	1,200 50
Hamilton Blast Furnace Co	2,973.54	....	8,920 60	......	8,920 60
Nova Scotia Steel Co............... ...	....	21,453.43	....	64,360 29	64,360 29
Totals	3,273.70	21,453.43	$10,121 10	$64,360 29	$74,481 39

The recent consolidation of iron and steel producing interests on a gigantic scale in the United States has turned the attention of the world upon the vast deposits of raw materials for the production of iron which that country possesses. It is the presence of these deposits, and not merely the combinations of capital and enterprise which self-interest can create and self-interest dissolve, that constitute the real basis for the apprehension felt in older countries that the industrial supremacy of the world is about to pass permanently to this side of the Atlantic, if indeed it has not already passed. To immense supplies of iron ore and coal are added physical and geographical advantages, such as great inland lakes whose waters make cheap freight rates possible in assembling materials, and an enormous territory within which trade is perfectly free and at liberty to adapt itself to conditions conducive to the greatest possible economy of transportation and manufacture. Other advantages are plants of maximum capacity, labor-saving and automatic processes, and elimination of the middleman's profits by uniting the ownership of iron ores, transportation facilities, blast furnaces and coal mines in the hands of individual firms or companies.

PROSPECTS OF IRONMAKING IN ONTARIO.

It is pertinent to ask whether these advantages are confined to the United States. Is it practicable for the Province of Ontario, for example, to enter upon the business of making iron and steel on anything like terms of even competition with the republic to the south of us? Even if her undoubtedly large stores of iron ore and abundant deposits of limestone furnish two of the three kinds of raw materials essential to the business, will not her coalless formations and distance from the seaboard heavily handicap Ontario in the struggle to supply the world's markets? These are questions which can only be answered by actual experiment, not by balancing conditions on paper. Nevertheless, there are many features which render the prospect before the developing iron industry of Ontario a promising one. To begin with, the home market is large and steadily increasing. The Province of Ontario with its mills, foundries, factories and railways, is a heavy consumer of pig iron. The career of industrial expansion upon which it has embarked must increase that consumption by leaps and bounds, and apart altogether from government assistance by bounties or tariffs, the home producer will necessarily enjoy the advantage conferred by proximity to his customers. There is now no doubt of the quantity and quality of Ontario iron ores, which are found in the western, central and eastern parts of the Province, and of fluxing materials there is no lack.

The prime test of the suitability of any locality for the iron smelting business is the cost of assembling the necessary raw materials, namely, iron ore, limestone and coke. In an address delivered at Toronto under the auspices of the board of trade on 15 February last, Mr. A. J. Moxham, general manager of the Dominion Iron and Steel Company of Sydney, C.B., enumerated four points in Canada where the actual cost of assemblage compared favorably with that at Pittsburgh, Pennsylvania, the greatest seat of the ironmaking industry in the United States.

Of these two were in Ontario, on the shores of lake Superior and in the eastern portion of the Province respectively; the others being in British Columbia and at Sidney. According to Mr. Moxham, the "actual freight cost" of assembling the raw materials at Pittsburgh amounts to $3.25 per ton of pig iron made; while at the iron mines on the Ontario shore of lake Superior the cost is given at $1.97 per ton only "or $1.28 lower than the Pittsburgh standard." Apparently in the latter case the cost of transporting the coal only is reckoned, nothing being allowed for either ore or limestone, which gives the comparison an air of being incomplete. As to eastern Ontario, Mr. Moxham states that here "exists ore of great promise, within reasonable distance of the coal of either the Connellsville or Punxsutawney districts. Independently of the local supply is the Canadian lake ore to draw from. This and the coal can be assembled within the Pittsburgh margin. At Sydney of course the freight charges are much below those at Pittsburgh, being indeed only 79½ cents per ton of pig iron, "the lowest assemblage cost in the world for the tonnage under consideration." On the question of steel production for foreign markets the general manager of the Dominion Iron and Steel Company makes out a still stronger case for Sydney when he says that, allowing one and a tenth tons of pig iron to a ton of steel the freight cost of assembling the raw materials for the latter at Pittsburgh is $3.57, to which must be added $2 per ton for delivery at tidewater, making $5.57 in all, while at Sydney the pig iron being already on the seaboard the freight cost of a ton of steel is only a few cents more than that of a ton of pig iron. If these figures be correct, the superiority of Sydney as a steel producing point is sufficiently manifest, and a power has arisen on the Canadian shore of the Atlantic ocean which must inevitably exercise a great if not a dominating influence in the iron and steel trade of the world. Exports of pig iron from Sydney to Great Britain have already begun.

It is to be noted that when Mr. Moxham speaks of the "freight cost" he is careful to point out that he means the "actual cost" of haulage to the railway and steamship companies, not the rates charged by them for their services. In all cases the latter must be in excess of the former, and in most cases they are very considerably in excess. This is quite evident when the cost of transporting ore from an upper lake port to a lower lake port, a distance of say 1,000 miles, is given as 50 cents per ton, and the average cost of railway freight at four-tenths of a cent per ton per mile; actual facts being that contracts are now being made for the season of 1901 to carry ore from Duluth to Cleveland for 80 cents per ton, and the rate on iron ore from Eldorado in Hastings county to Hamilton, a distance of 170 or 180 miles at the present time is $1.10 per ton.

When the British-built boats employed by the Lake Superior Power Company to carry iron ore from the Helen mine to Midland last summer returned to England in the fall to engage in the ocean carrying trade for the winter instead of lying up for six months in some lake harbor, they bore cargoes of steel from the works of Andrew Carnegie; and if steel made in the United States can be exported profitably in this way, there does not seem to be any good reason why the same thing cannot be done with steel made on the Ontario side of the great lakes, particularly if the cost of accumulating the raw materials is lower than south of the line. But whether the foreign market is available or not, the home market remains. New Ontario is to be conquered and subdued to civilization. Railways are to be built, requiring iron and steel for rails, bridges, locomotives and cars, mineral deposits are to be opened up and forests are to be felled, pulp factories, sawmills and many kinds of woodworking establishments are to be called into being and equipped with machinery, and above all, great areas of cultivable soil are to be taken possession of by the farmer, whose calling demands manufactured iron and steel in a thousand forms. Old Ontario and New Ontario combined will absorb an immense amount of iron and steel, and even the prairies of Manitoba and the Northwest may yet be cultivated by ploughs and harrows fashioned from Ontario ores. The outlook for the iron industry of the Province was never better than now, and never was so much being done by the industry to meet the situation.

EXPLORING FOR ORES.

Exploring for iron ore goes on in various parts of the Province. One of the Government diamond drills has been at work for over a year on the Mattawin iron range west of Lake Superior, and the borings have indicated the presence of large bodies of ore, much of which, however, is somewhat low in metallic contents. Tests have also been in progress on the Atikokan range. Over a year ago Mr. R. M. Hunter, of Duluth, took an option on locations 10 E, 11 E and 12 E, owned by Mrs. J. C. Graham and McKellar Bros. of Fort William, paying $10,000 cash and agreeing to pay a further sum of $146,000 by the first of May if the option to purchase were exercised. Another condition was that Mr. Hunter should purchase all the locations on the range owned by the above-named parties, 16 in all, and being 21 to 27 E, 86 E and 100 to 104 E for the price of $420,000, but it is not certain that more than the three properties 10, 11 and 12 E will at this time change hands. A tunnel 400 feet long, driven into the mountain at its base and about 100 feet below the summit showed a thickness of over 80 feet of ore. Considerable work has also been done recently with diamond drills. Several American experts have reported favorably on the locations, and it is said the American Steel Wire Company will complete the purchase and work the deposits on a large scale, shipping the ore to smelters in the United States. The Lake Superior Power Company have been actively prospecting for ore in the Michipicoton Mining Division and along the proposed route of the Algoma Central Railway.

The report of Professor Coleman on the Iron Ranges of the Lower Huronian and of Professor Miller on the Iron Ores of the Nipissing District, published in this volume, will be read with interest as revealing something of the enormous extent of this Province over which geological and mineralogical conditions exist favorable to the occurrence of iron ore. The features characteristic of the famous iron regions on the south shore of Lake Superior appear to be paralleled, if not duplicated, in our own territory, and there is reason to believe that many large deposits will yet reward the patient prospector.

NICKEL AND COPPER.

The production of nickel in 1900 was much greater both in quantity and value than in 1899, being 3,540 tons worth $756,626 in the matte as against 2,872 tons worth $526,104, an increase in quantity of 668 tons and in value of $230,522. The same thing is true of copper, the output last year being 3,364 tons worth $319,681 as compared with 2,834 tons in 1899 worth $176,236, an increase of 530 tons in amount and $143,445 in value. It must be borne in mind that the figures of value given here are those for the metals in the form of matte before being exported for refining. If the price of the fine metals were made the basis of computation, the values would be many times increased.

The subjoined table gives the statistics of ore raised and smelted last year along with similar data for the eight years previous.

Year.	Ore raised, tons.	Ore smelted, tons.
1892	72,349	61,924
1893	64,043	63,944
1894	112,037	87,916
1895	75,439	86,546
1896	109,097	73,505
1897	93,155	96,093
1898	123,920	121,924
1899	203,118	171,230
1900	216,695	211,960
Totals	1,069,853	975,042

Details as to products and labor are embodied in the following table, which covers also the four preceding years for purposes of comparison :

Schedule.	1896.	1897.	1898.	1899.	1900.
Ordinary matte ..... tons	9,733	13,706	21,101	19,109	23,336
Bessemerized matte ..... "	......	328	....	106	112
Nickel contents ..... "	1,948½	1,999	2,783¾	2,872	3,540
Copper contents ..... "	1,868	2,750	4,186¾	2,834	3,364
Value of nickel ..... $	3[illegible]7,000	359,651	514,220	526,104	756,626
Value of copper ..... "	130,660	200,067	268,080	176,236	319,681
Wages paid ..... "	247,151	253,226	315,501	443,879	728,946
Men employed ..... No.	485	535	637	839	1,444

Producers of nickel and copper had the advantage of an active demand throughout last year, and the average price realized for both metals was higher than for a number of years previous. Especially was this true of nickel, the selling price of which in the New York market advanced from about 35 cents per pound in January to 55 or 60 cents per pound in December. The average value of the nickel contents of matte at the Sudbury works as returned to the Bureau was $213.73 per ton or 10.686 cents per pound, and of copper $95.03 per ton or 4.756 cents per pound. These figures compare with $183.18 per ton or 9.159 cents per pound for nickel, and $62.18 per ton or 3.109 cents per pound for copper in 1ö99.

The returns as to labor showed 1,444 employes at work in the nickel and copper mines of the Province, of whom 348 men and 2 boys were underground workers and 1,029 men and 23 boys were engaged above ground.

The Canadian Copper Company continues to be the chief producer of both copper and nickel, and its operations at Copper Cliff were on a larger scale than ever. Dr. Ludwig Mond is equipping his property at Victoria Mines with a modern mining plant and smelting works suitable for the production of high grade nickel-copper matte. A Chicago syndicate, of which Mr. Maier Neumann is manager, is devoloping the Sultana nickel mine in the township of Trill, and the Lake Superior Power Company are opening up the Geitrude mine in Creighton township.

In the last report of the Bureau of Mines there was published a brief description of Mr. H. A. Frasch's process for recovering and refining nickel by electrolysis.[5] This is now supplemented by the following information afforded by the inventor himself :

The Frasch process as applied to nickel matte may be said to consist of three principal operations ; (1). The production of the solution of the metals contained in the matte. (2). The recovery of the copper. (3) The separation of the nickel.

The details of the process are covered in the first instance by United States Patent No. 669,441 which fully describes the process so far as the obtaining of the solutions is concerned. These solutions are then subjected to electrolysis in an apparatus identieal with the one in which the solution is originally obtained and the copper is here removed. After the copper has been exhausted from the electrolyte the remaining solution is then treated in accordance with United States Patent No. 669,899, and the nickel is precipitated in the form of nickel ammonium chloride, all the other metals remaining in solution ; the nickel salt is recovered by filtration and from it the metallic nickel is deposited by electrolysis, the ammonia being recovered and used over again.

[5] Rep. Bur. 1900, p. 222.

Heretofore in electro-metallurgical processes where soluble anodes have been employed, the same electrolyte has been used over and over, so that in a short time the electrolyte became contaminated with impurities which increased the resistance and damaged the product. In this process the electrolyte is used but once, and then entirely exhausted, while the salt brine which has served as a solvent, after the final process in which the ammonia is expelled is used over again and is then in a perfectly pure state.

In view of the fact that some further developments of the process are still to be protected by patent, the means used to separate other metals from the mother liquor after the copper and nickel are separated are not explained by the inventor.

In purely copper ores, the old Bruce mines are undergoing complete renovation at the hands of The Bruce Copper Mines, Limited, an English company. Extensive works for the treatment of the ore are in process of erection.

At Rock lake also the Rock Lake Mining Company, Limited, are placing in producing condition a large and promising copper vein, the ore from which will be treated in the large concentrating plant now being put up. The railway from Bruce Mines on the shore of lake Huron to Rock Lake, which was granted aid by the Legislature at its recent session, will be of material assistance to this company in greatly cheapening the transportation of machinery and supplies.

The Ontario Smelting Company is exploiting a copper vein near Massey Station, and is also building a refinery or rather a matte-concentrating plant at Copper Cliff for the purpose of smelting the copper ores from the Massey Station mine and of increasing the metallic contents of the Canadian Copper Company's mattes.

In eastern Ontario, the McGown and Wilcox mines near Parry Sound shut down about 1 December, after running in a fairly steady way for a considerable time. It is understood that work will be begun again in the spring. The Helena mine in the township of Barrie, Frontenac county, was in operation for the whole of the year and is said to promise well. It is not yet in the producing stage.

Gold and Silver.

The yield of gold in 1900 was 18,767 ounces valued at $297,861, as compared with 27,594 ounces worth $424,568 in 1899. Bullion was produced on 18 properties as against 15 last year. Statistics of gold mining for the last five years are given in the following table :—

Schedule.		1896.	1897.	1898.	1899.	1900.
Mines worked	No.	8	9	17	15	18
Men above ground	"	103	222	296	307	412
Men under ground	"	86	236	284	356	338
Ore treated	tons	13,292	27,589	57,895	59,615	46,618
Gold product	oz.	7,154	11,412	16,261	27,594	18,767
Gold value	$	121,848	150,244	275,078	424,568	297,861
Wages paid for laoour	"	91,210	217,766	290,919	324,024	350,694

The immediate cause of the diminution in the output of bullion was the stoppage of several producing mines in western Ontario, notably the Golden Star and Olive, whose mills ran for only a portion of the year. The western gold fields have no doubt been the scene of much mismanagement and waste of money in ill-directed efforts at mining, and it cannot be denied that among the companies which have been formed there are those which have devoted more of their energies to the sale of stock than to the work of sinking on their veins. Some have spent their funds

in attempts to find paying ore in barren country rock ; some on promising locations have reached the end of their money in the early stages of development and have been obliged to stop with an unproven and unsaleable mine on their hands because unable to obtain more capital to go on with ; while others have committed the evergreen blunder of putting up expensive mills and plants before demonstrating the continuity and richness of their deposits. The gold ores of western Ontario are not high in grade, but for the most part they are free milling, and the veins are of good size. There is abundance of wood, water and good labor ; and mining, when conducted with skill and prudence, can reasonably look for an abundant reward.

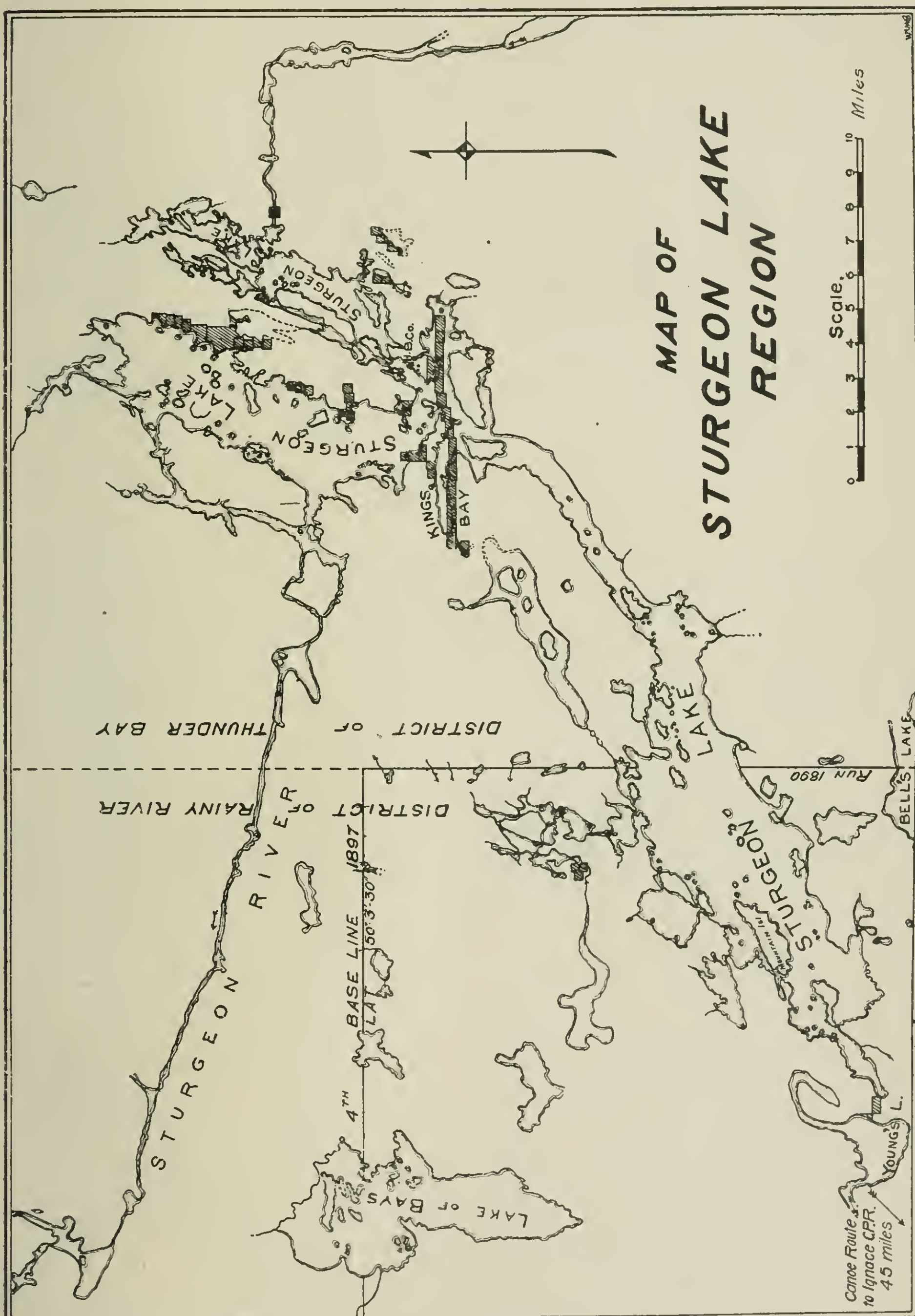
There is prospect of resumption of work by both the Golden Star and Olive mines mentioned above, and also by other mines which have been temporarily closed down. The construction of the Ontario and Rainy River Railway through the southern portion of the Rainy River district will cheapen freight charges on supplies, and enable mining to be carried on in winter as well as in summer.

Experience with non-assessable joint stock companies has tended to cast doubts on the wisdom of this plan of organization. No doubt the plea that the purchaser of non-assessable shares cannot be called upon for further contributions assists the sale of stock and helps to float a company, especially in seasons of excitement ; but this very exemption may be fatal to a company's success when the critical moment arrives which finds development work imperatively demanded and the treasury empty. If such work is not immediately remunerative, operations must cease, for the shareholders cannot be levied upon, and there is no other source of revenue. This may happen, too, just at a time when a little expenditure might put a promising property beyond doubt or failure. In an assessable company, if the capital is not fully paid in already, a call can be made and funds procured for continuing the work. In at least one case, these considerations have proven so cogent as to bring about the re-organization of a gold mining company with a producing mine, which has accordingly changed from a non-assessable to an assessable basis.

GOLD DISCOVERIES ON STURGEON LAKE.

The gold-bearing area of the Province is constantly being enlarged by the discoveries of prospectors and explorers, those hardy pioneers who blaze out the paths for enterprise and capital to follow. One of the newest of Ontario's gold regions is that of Sturgeon lake, which is situated partly in the Rainy River and partly in the Thunder Bay district some 80 miles north of Ignace station on the Canadian Pacific Railway. Gold was found in this lake in the autumn of 1899, but in the spring and summer of 1900 further discoveries were made, and from some of the locations remarkably fine specimens showing free gold in abundance were obtained. Little is yet known of the geological conditions of the region, but veins varying in width from four to fifteen feet are reported as well as huge dikes several hundred feet wide carrying gold, it is alleged, across their full width.

The size of these dikes or veins is a characteristic of the locality. Mr. G. B. Abrey O.L.S., who surveyed many locations on Sturgeon lake last year, states that he sometimes found it impossible to get the vein inside the limits of a 40-acre location. Little or no development work has yet been done on any of the properties. About the only tests are those which have been made by Mr. Shores of Duluth, who sank on a vein carrying visible gold with, it is said, somewhat disappointing results. Surface showings however are unusually attractive, and a 10-stamp mill was taken in over the ice in January, 1901, by a St. Catharines company of which Mr. H. D. Symmes is manager. Mr. Symmes, who is a graduate of the School of Practical Science, Toronto, furnishes the following information respecting the region.


MAP OF
STURGEON LAKE
REGION
Scale.
0 1 2 3 4 5 6 7 8 9 10 Miles
STURGEON RIVER
DISTRICT OF THUNDER BAY
DISTRICT OF RAINY RIVER
4TH BASE LINE
LAT 50°3'30"
1897
LAKE OF BAYS
KINGS BAY
STURGEON
STURGEON
LAKE
STURGEON
RUN 1890
BELL'S LAKE
YOUNG'S L.
Canoe Route to Ignace C.P.R. 45 miles

"I became interested in the Sturgeon lake district in November last on the report of a prospector named Hare who was in my employ. I visited the locality and took up locations B G 155, 156, 157, 158 and 159 which are situated on the northeast arm of Sturgeon lake, containing 40 acres each. Mr. W. H. Cobb of Ignace was the discoverer. There are two veins on the property, one 4 feet wide, the other being much wider. They run north 10 degrees east parallel to each other, and lie in an area of porphyry about 300 feet wide situated between trap rock on one side and granite on the other. The walls are well defined. On one side of the large vein the rock has been eroded, leaving the vein sticking up in some places as high as 60 feet. Strange to say, the eroded rock is the granite, not the trap. Glacial action has laid the veins bare from one end to the other. The filling is quartz, very white in color, except on the selvage, where it has been colored by weathering of the iron pyrites. Besides gold and silver, the minerals occurring in the vein matter are iron and copper pyrites, zincblende and galena, the last-named in considerable proportion. Visible gold occurs in association with the galena, and is disseminated throughout the body of the quartz, all of which will show colors in the pan.

In my opinion the gold-bearing area will be found of limited extent, and the discoveries will be confined to the line of contact between the granite and the trap. The timber of the region is of the usual varieties, consisting of tamarac, spruce, cedar, birch and black poplar. It is large enough for the building of miners' shanties and timbering the mines. There is good trout fishing in Sturgeon lake. The district is not suitable for agriculture."

The canoe route from Ignace station is a good one, the water stretches being long and the portages short. The discoveries of free gold have excited a good deal of interest, and there is likely to be a considerable influx of prospectors when the spring opens.

ANGLO CANADIAN GOLD ESTATES, LIMITED.

A license of occupation dated 17 October, 1900, was granted to the Anglo-Canadian Gold Estates, Limited, an English company, having a capital of £61,000, authorizing them to explore for minerals on five separate areas in the district of Rainy River, containing in all 117 square miles and situated as follows: (1) part of timber berth No. 61 north of the Seine river and west of a line drawn due north from the 38th mile post on Niven's first base line; (2) timber berth No. 1, east of Crow lake, east of Lake of the Woods; (3) parts of timber berths D3, D4 and D5, south of Lower Manitou lake; (4) the Dick and Banning timber limit south of Calm lake, and (5) a block south of Sturgeon falls on Seine river west of the Dick and Banning timber limit.

The terms of the license of occupation called for an expenditure by the company in exploration, mining and development work of $35,000 in the year ending 1 January, 1901, and $40,000 and $45,000 respectively in the two following years. The money was not to be laid out in one or two blocks, but the company were bound to thoroughly explore the whole five blocks for mineral, and were to be permitted to buy or lease any locations which they might find to be valuable. A further condition was that at the end of the first year, namely on 1st January, 1901, the company were to relinquish a block or blocks to the extent of one-quarter of the aggregate area, to the extent of one-half on 1 January, 1902, and the remainder on 1st January, 1903.

The work of exploration was vigorously carried on during 1900, and on 13 February, 1901, Mr. Alan Sullivan, C.E., the company's manager, submitted the following report of the season's operations.

"Sinking was continued on the Reliance mine to a depth of 94 feet. Near the bottom of the shaft, owing to the lode changing its dip and strike, we did about 30 feet of cross-cutting, and at 60 feet from the surface we did about 80 feet of drifting. It being decided that further underground exploratory work was necessary before committing ourselves to a permanent scheme of development, actual mining has been suspended at this point for the last six months, until the property can be further exploited by the company's diamond drill.

Prospecting work was resumed as soon as the snow left the ground upon some of the areas covered by our license of occupation. Prospecting on the south side of the Seine was deferred until the nearer approach of the Rainy River Railway, and our men carefully examined timber berth number 61, resulting in the discovery of what is known as the Elizabeth mine. This find was made in July and development work has been progressing actively since that date. The ode consists of a series of quartz lenses crossing from chloritic schists into altered granite.

These lenses vary considerably in size and value, the richest point being at or near the point of contact. Outcrops are traceable upon the lode for nearly half a mile. The quartz is greenish gray in color, sugary in texture, carrying gold, native copper, copper sulphurets, iron sulphurets and in places galena. The dip of the lode is about vertical, and the pitch of the ore chutes, as determined so far, is toward the south, in this respect following the general rule of such chutes elsewhere in the district.

So far we have done 210 feet of development work, consisting of No. 1 shaft, 94 feet deep, with about 80 feet of drifting at the 80-foot level ; No. 2 shaft, 20 feet deep, and several test pits. The width of the chute underground varies from 3 to 5 feet, and in value from $8 to $12.

The company purchased last autumn a Bullock Beauty diamond drill. This machine is good to a depth of six or seven hundred feet, and takes out a ⅞-inch core. It has been in successful operation for the last month, and is proving of great value in determining the pitch and trend of the lode. I intend so far as possible to block out all development work by means of this machine. We have done at time of writing about 450 feet of drilling. The price of black diamonds has been so high that I have been using carbon borts, with most satisfactory results. The drill foreman is Mr. James Cuthbertson. The motive power for this machine is an 8-h.p. Waterous boiler ; the water is furnished by a small duplex Snow pump. Our average rate of progress so far has been from 120 to 130 feet a week, and the cost has been considerably below that at which we could contract the same work. I would most emphatically advise those who are in a similar position to avail themselves as much as possible of the services of a machine of this kind as by its means a great deal of most expensive and possibly unprofitable development work may be avoided. I estimate that an expenditure of $900 per month would be ample to cover all outlay and keep the diamond drill crew running full time.

The only plant on the ground with the exception of the drill above mentioned, is a Fraser and Chalmers horse power whim, 30-inch drum, capable of hoisting from 600 to 800 lbs. with a speed of about 60 feet a minute. Camp buildings, etc., magazine, store-house, stables and blacksmith shop, to provide for about 30 men are erected.

The number of men employed on the property at the time of writing is 20, consisting of foreman, cook and helper, blacksmith, 7 miners, 5 men on diamond drill, 3 surface men and a teamster.

The intention of the company is to develop two or more of the chutes on this lode before erecting a mill, and thus secure a constant supply of ore.

Our work during the present year will be considerably facilitated and greatly cheapened by the construction of the Ontario and Rainy River Railway, which passes through a large part of the ground under license to us.

The total expenditure to date on the Reliance, Elizabeth, prospecting, plant, supplies, realty and salaries, has been about $50,000."

The falling-off in gold produced was to some extent made up by the increased output of silver, of which 160,612 ounces worth $96,367 were produced in 1900 compared with 105,467 ounces valued at $65,575 in 1899. The silver mining statistics for the last three years are given in the following table, showing a constant and somewhat rapid increase since the revival of this branch of mining in 1898 :

Schedule.	1898.	1899.	1900.
Ore raised.......... tons	6,600	8,000	12,500
Ore stamped .... "	5,600	8,000	8,000
Bullion product.......... oz.	86,600	105,467	160,612
Value of bullion.......... $.	51,960	65,575	96,367
Wages paid for labor.......... "	28,430	29,000	24,000
Average workmen above ground.......... number	32	23	20
Average workmen below ground.......... number	27	17	30

A small quantity of the silver is obtained from the gold ores of some of the mines of Rainy River district, but the bulk of it is the product of one mine in the silver region west of Port Arthur.

MINING ACCIDENTS.

The number of accidents for the past year was somewhat larger than in the preceding one, the total amounting to 31, of which 17 were fatalities, 10 serious and 4 slight. Of the total 16 were due directly to explosions of powder in one way or other, and of these again 9 were caused by carelessness on the part of the injured persons and 3 to ignorance, while 4 were purely accidental. Of the other accidents only one can be traced to intentional disobedience of instructions, and this is the accident at the Belmont mine where two men fell out of a skip after receiving sharp orders not to ride therein. Of accidents occurring on the surface 5 were due to causes quite distinct from mining, but happening at, and to the employes of, working mines they are here included.

There is a marked tendency on the part of many managers, or those in charge of mines, to comply with the regulations in the Mines Act designed for the safety of workmen, the provisions now being enforced with a personal desire to profit by them. In the past year or two and under the new Act it has been noticeable how all safeguards are being enforced as strictly as possible, so that in cases of accident the responsibility may rest elsewhere than on the management. It is now to be hoped that under the influence of this example the employes themselves will discard some of that carelessness which is bred of long exposure to danger and immunity from mishap.

At the Sultana Gold Mine.

During the year two accidents occurred at this mine involving four men, three of whom were killed and one injured.

In the first mishap, which occurred on New Year's day, two miners named John Olson and Charles Tonstron were killed. They were engaged thawing powder on the first level at 75 feet north of the shaft where the powder box for that level was kept. By the sudden explosion of the dynamite they were instantly blown to pieces. There were, of course, no witnesses to the calamity, but at the time a large shift of men were underground and these feeling the effects of the blast started for the surface, meeting the foreman and others going down to investigate. They found the ladderway and skiproad wrecked at the first level in the shaft, but managed to get far enough into the drift to see pieces of human bodies scattered about. Everyone was then ordered out of the mine until an inquest could be held.

The result of the different investigations by both the coroner and Inspector Bow may be summed up as follows: On the day preceding that of the accident, two boxes of dynamite, or 100 lbs., the proper supply for 48 hours, were taken down and placed beside the powder box in a side stope on the first level. Next morning at about 7.10 Olson and Tonstron were here preparing powder for a blast, using an ordinary thawing can. This consists of two compartments, an inner and an outer, between which water is placed and heated, in this case by steam, several sticks of dynamite being placed in the inner tin. Beyond this point the actions of the two men are not definitely known, but it is the unanimous opinion of all the witnesses that through carelessness the deceased allowed the water to become too hot, with the result that the dynamite exploded. The temperature of the water should never rise above that which the hand can bear, and it is thought that the men neglected to apply this test.

Both Olson and Tonstron were experienced miners supposed to be well versed in the handling of explosives, and besides this more than the ordinary care appears to have been exercised by those in authority at this mine to insure safety in the use of explosives. The explosion knocked holes through the timbered floor and roof of the drift allowing the waste pile above to shoot down and cover the remains of the bodies with debris.

The second accident occurred on 21 July, and was also the result of an explosion. Two men, Adolph Hedlund and August Anderson, were injured, the former dying soon afterwards.

Anton Johnston, a chore-boy at the boarding house, had seen lying on the lake shore the inside tin of an old powder thawing-can and being of a frugal turn of mind determined to make a spitoon out of it for the camp. He could not find the machinist from whom to borrow shears, so the blacksmith Hedlund learning that he wanted the can cut in two offered to do the job, and began with the cold chisel against the anvil, his helper Anderson swinging the hammer. Johnston knew nothing about dynamite or thawing-cans, but Hedlund did ; however, the can appeared to be clean, Hedlund making some remark to that effect, and he had cut all but about two inches when on the stroke of the hammer the nitro-glycerine exploded and broke the tin into fragments, one of which entered Hedlund's neck severing the jugular vein and causing him to bleed to death in a few minutes. Anderson was struck by several pieces but not very seriously injured, while Johnston who was standing looking on was not hurt at all. Anderson was removed to the hospital where a week later he was reported as improving steadily.

This powder can had with some others been thrown into the lake through the ice in the winter time when the water was high, but during the summer became exposed where Johnston found it. In the process of thawing dynamite more or less nitro-glycerine will sweat out, hence the can requires frequent cleaning and after a time must be thrown away—preferably burnt or exploded—as the explosive accumulates in the corners ; or the tin may leak. If this tin had been burnt or exploded, as is required by the Mines Act, no accident could have resulted, and on the other hand Hedlund being experienced should have apprehended danger, the mere fact of the can appearing clean being no proof of its being so, as nitro-glycerine is colorless.

At the John Sykes Gold Mine.

This property lies about 37 miles north of Dinorwic, C. P. R., and here on 12 February by an accidental explosion two men, Joe Greenwood and Frank Potvin, were killed as they were working in an 8-foot test pit about 300 feet south of the main shaft. As there were no witnesses the evidence taken had to be entirely circumstantial, for though Greenwood lived for 15 minutes and Potvin one hour after the mishap, both were so badly injured that neither regained consciousness sufficiently to give any account of the occurrence.

The manager was at the main shaft where the powder was stored expecting the men would come for their charge at any moment when the unexpected explosion startled him, and knowing they had received no powder at the pit he at once went over followed by three other miners, and found the two men stretched out insensible at the bottom. There appeared to be no doubt that the men were drilling at the time judging from their position, the nature of the injuries, and also from the fact that the hammer Potvin always used could not be found, having been blown out of sight. As there had been no missed holes for several feet back the only inference possible is that they were drilling in the bottom of an old hole in which some powder remained unexploded from a previous charge, which is quite a possible circumstance, and that the drilling set this off. The men knew but little about mining, and probably had never been told how rigidly the temptation to use old holes as starters has to be avoided for fear of this very result.

At the Golden Star Mine.

On 14 April while working in the stope on the third level north, Frank Anderson, a miner, was seriously injured. He was descending along the face of the stope, which is inclined at about 35 degrees, when the rope fastening holding up the ladder gave way and he was shot down against a stull, breaking his leg above the knee.

Anderson's version of the cause of the accident is that by his own carelessness he did not fasten the rope securely enough on the ladder. He was taken to the mine hospital where his leg soon began to mend.

At the Foley Gold Mine

At this mine in the Lower Seine region a serious accident happened to Peter McEachern, a teamster. On 8 June while employed hauling timber from the north to No. 5 shaft, one of the sticks rolled off the load, carrying McEachern with it and in the fall he sustained a compound fracture of his right arm at the wrist. He was at once taken care of by the mine surgeon and at the last report shortly after the accident was doing well.

At the Mikado Gold Mine.

A trammer named John McGuire was seriously hurt on 12 July while working in this mine. He had been sent by the mine foreman to the 120-foot level to lay track, and it appears that his supply of spikes ran out and instead of going to the surface for more he descended to the 180-foot level to borrow some from John Bryson who was also laying track there. Before returning he started without any authority to help Bryson with his work, the latter holding the gauge and McGuire striking, and as McGuire was in the act of driving in a spike about 18 inches from the mouth of the winze leading to the next level below, his foot slipped and he fell down some 50 feet in the winze, breaking his arm and sustaining a compound fracture of the leg.

According to the investigation made into the circumstances by Inspector Bow the accident was due largely to carelessness on the injured man's part, though had there been a guard rail across that side of the mouth of the winze (as there was on the other side) in accordance with the Mines Act, it would not have happened. McGuire was put immediately in the mine doctor's care and next day removed to the Rat Portage hospital, whence a week later it was reported that he was doing well, but that it would probably be two or three months before he fully recovered.

At the Canadian Copper Company's Mines

During the year eight accidents have occurred at the above mines, from the effects of which five men died, three being seriously injured and one man slightly hurt. The investigations show that six of the mishaps were due to carelessness on the part of the men themselves, two purely accidental, while one, that to Joseph Ruble, may be classed under both heads.

The first accident occurred 2 February to James McGregor, and proved to be no more than serious. McGregor was a watchman at No. 2 mine and at 6 p.m. while standing on the steps of the dry-house near the mine, the blasts went off and he was struck in the back by a piece of flying rock. He had been repeatedly warned not to expose himself at times of blasts, but did not heed instructions, for the mine boss had just passed him going out to notify others coming that way, and on all other roads approaching the mine at the time men were posted to warn people of the coming blasts, so that no one but the man himself was to blame. At first the injury was thought to be very serious, but McGregor soon began to improve and by the end of the month was able to resume his work.

In the second mishap on 17 April, William Thompson, a block-holer in the mine, received a serious injury while blasting some ore. He had set off three fuses, but with the fourth one the powder had not been sufficiently covered up and a spark while lighting the fuse fell into it causing a premature explosion. Thompson's face was more or less lacerated and his eyes injured, so that he had to be taken to the Sudbury hospital from which, after a lapse of ten days reports were received that he would undoubtedly recover, but it was a question whether he would ever regain his eyesight.

The third accident proved fatal to the injured man, Joseph Ruble, a laborer working in the roast yards of this mine. At about 8 p.m. on 29 May Joseph Ruble and his brother John were removing ore from one of the roast piles, when a quantity of rock broke loose from above

them sliding or rolling down about 10 feet to the end of the pile. John Ruble was struck on the ankle and knocked down receiving some slight bruises, while Joseph was caught and partly covered up by the rock, which inflicted internal injuries. He was immediately removed and medical aid summoned, but next morning, twelve hours later, he died. Apparently the mishap was due to carelessness on the part of the men themselves, for the manager reports tnat they were constantly being warned against placing themselves where any such accident as this might occur.

On 10 July Samuel Hogue received injuries which caused his death two days later. While the deceased and another, William O. Lewis, were engaged filling in a culvert under the trestle road which runs past the roast heaps to the smelter, at 546 feet from No. 3 roast pile where blasting operations were going on, the warning danger signal for a blast was given. Both men heard it, but Lewis alone moved to a place of shelter a short distance away. Hogue remained where he was, standing erect with his feet on the culvert and between the ties and was there hit on the forehead by a flying particle from the blast, the stone first striking and glancing off the rail at a point 56 feet from Hogue's position. It cut him above the eye and injured the blood vessels to such an extent that clotting occurred in the brain cavity causing death. The accident seems to have been unusual, in that the distance from the blast was so great that little danger would ordinarily be apprehended, and Hogue apparently for this reason paid no attention to the signals. Certainly the chances were greatly in his favor, as no other blasted chunks of rock could be found farther than 385 feet from the pile. But Hogue was himself to blame for not taking advantage of the safe retreat within a few yards of the spot as did his partner. The coroner's jury brought in a verdict that Hogue came to his death by his own carelessness.

Another serious injury happened to one Elias Knopiala on 13 August. During blasting operations at the roast heap two holes had been drilled, loaded and set off at the same time. After one of the shots had been exploded, Knopiala returned to the heap just in time to be struck at close quarters by the second explosion, receiving serious cuts and bruises about the head and face from the fragments of flying rock. Knopiala knew that two shots were to be fired, for he had assisted in drilling both holes ; and the charges were not in hot ore which might have caused the premature explosion of the first hole. The only probable reason therefore for his hasty return is that he believed both shots had gone off together. The doctor reported a week later that the injured man was recovering as quickly as possible.

The sixth accident happened at the mine on the afternoon of 27 August, by which James Beatty lost his life. Two men, Beatty and John McCarthy, had been sent by their foremen to put a truss under one of the flat cars, a job requiring about 20 minutes' time.

This car and three others were coupled together and standing on a track leading down a six per cent. grade from the rockhouse where other cars were being loaded, to be in turn dropped down with a brakeman at the head of each with just sufficient force to connect the automatic couplers. Instead of obeying their foreman's instructions and notifying the rockhouse workmen to hold all cars, they immediately started on their repairing job both getting underneath the car. Beatty was lying across the rail almost touching one of the wheels, when a loaded car came slowly down from the rockhouse and coupled with the standing four with a bump which caused them all to move forward about three feet and one of the wheels passed over Beatty's back just above the hips, causing his death about 20 minutes later. McCarthy escaped unhurt.

Instructions have apparently always been given to men when on work of this kind to use the greatest precaution in watching for other cars or engines and in taking any necessary steps, when possible, to stop the traffic temporarily. McCarthy acknowledges that the accident was due to their own negligence, and this was also the verdict of the coroner's jury.

On 4 September at 8 p.m. another accident occured injuring two men, Gus Johnson and John Kutjee, the latter but slightly, while the former died two days later. The 10th level in

the mine was the scene, and here after 7 sand blasts had been set by the regular blockholer, Dick Ball, the attending miners, Gus Johnson, John Kutjee and Pete Kylloven started together to fire the fuses. The two latter had already got their first fuse burning while Johnson was still engaged firing his, and before they had fairly got their second ones going Johnson's first one exploded, the flying rock cutting him up very badly, and inflicting some flesh wounds on Kutjee. Kutjee and Kylloven made a rush for the shaft and then heard Johnson cry out. At the shaft, about 100 feet away a trammer named Isaac Kosola was standing, and on meeting the two men and hearing the cry, he coolly and bravely ran in while the other four fuses were burning and carried out Johnson. The injured man was quickly taken up to the surface in the skip and handed over to the doctor's care at the Sudbury hospital. It appears that several bones were broken, his arms and body punctured and badly bruised and burned. He was completely prostrated by the shock, from which he never entirely rallied and finally died from gradual internal hemorrhage.

Inspector De Kalb made a formal investigation into the causes of the accident and submits as his opinion based on the evidence given : "that there was apparently no carelessness nor disobedience of order either on the part of Gus Johnson or of those who were working with him at the time of the accident. The fault seems to have been with the fuse which set of the blast at least 30 seconds too soon. This many have been due to defective fuse or to a short-circuiting in the coil of the fuse by burning through. This would have reduced the effective length of the fuse one foot or more causing the explosion within 30 to 35 seconds of the time of lighting."

The last accident at this property during the year happened on September 26th when Antonio Garafala, an Italian laborer, met his death.

At 6.45 a. m. while on the way home from work Garafala came to the crossing of the railroad tracks leading to the new or west smelter at the same time that a train was approaching composed of loaded ore cars being shoved up grade at about 8 miles an hour by the engine in the rear. The fireman was at the time running the engine while the engineer put sand on the rails which owing to the drizzle of rain had become slippery.

The deceased was seen by the fireman approaching the track and the usual train signals were given, but Garafala kept on apparently in mental abstraction looking neither to right nor left and stepped on the track out of sight, and as the firemen thought getting safely over. The train foreman on the car next the engine had also observed the man, and thought all was well till he heard his car jump and knew they had run over something. After going to the other side of train train but not seeing the man on the road he immediately stopped the train. They found the deceased lying on the track a few feet behind the engine, all the train having passed over him cutting off both legs, the right one near the trunk. As soon as possible he was put on a stretcher and carried to the warehouse nearby, the doctor getting there at the same time. The latter had him removed immediately to the Sudbury hospital, where from the effects of the injuries he died about two hours later. Clearly the deceased was the only one to blame, for besides the warning train signals heard distinctly by others farther off there was an unobstructed view of the track for 400 yards.

At the Victoria Nickel Mine.

On 9 June at 10 p.m. an accident happened at the Victoria nickel mine near Whitefish which resulted in the death of John Donnelly and John French. A piece of timber fell from the top of the shaft down to the bottom where the two men were standing, striking them about the head and shoulders with the above result.

The immediate cause of the accident is not positively known. The story of the man at the top of the shaft is that the men below called up for the water barrel to be lowered, they having the waste bucket at the bottom of the shaft where they were working. He hooked the rope

to the water barrel and told the man at the whim to hoist away so that the barrel would clear the collar of the shaft. The horse was started going and the barrel swung clear but at the same moment a stick of timber on which the water barrel had been resting was seen to roll over the collar of the shaft and disappear. The man at the top shouted down the shaft to see if anyone were injured and was answered by one of the three men who were below, this one having been in the drift when the timber fell and thus escaped. It was found that the other two had been instantly killed. The presumption is that a hand chain on the bottom of the barrel had become entangled with the timber on which the barrel rested, and in the hoisting away had hauled the timber over too, dropping it down the shaft.

At the Helen Iron Mine.

At the Helen iron mine, Michipicoton, an accident occured at 3.50 a.m. 30 October, to one John Bishop resulting in the fracture of his leg below the knee. The injury was caused while working in the pit of this mine by a lump of ore, which his companions above were dislodging, rolling down the side of the pit and striking him in the leg with the result stated. The men shouted a warning down to Bishop, but he ran the wrong way and towards instead of away from the rock. He had full knowledge of what was being done in the pit above him and paid too little heed when the cry came, so that no one was to blame but himself.

At the Felmont Gold Mine.

At this mine, the property of the Cordova Exploration Company, situated near Marmora, Hastings county, during the year six men met with accidents, five of which proved fatal.

The first disaster occurred on 24 July by which two men, Louis Dufresne and Peter Terrion, miners, were instantly killed. A coroner's inquest was held and the following written verdict rendered: "That the said Louis Dufresne and Peter Terrion came to their death by accidentally falling from the skip or hoist at No. 2 shaft at the mine of the said company in the said township of Belmont, and we censure the deceased for riding on the said skip contrary to the rules of the said company, and George Avery, foreman, for allowing them to do so."

The inspector of mines, Mr. Courtenay De Kalb, also made an inquiry into the circumstances of the accident, his report being summarized here as follows: The manager had given orders to the head foreman, Thomas Fisher, that the men were not at any time to use the skip for going up or down the shaft, and he also had notices posted to this effect, quoting the Mines Act. On the night of the accident the head foreman was underground between 9 and 9.30 o'clock, and left instructions with the night foreman, George Avery, that the men, after loading and firing the holes in the crosscut from the side and near the bottom of No. 2 shaft where they were working, were to descend the few feet to the bottom or second level and run along this to No. 3 shaft going out that way. The two deceased were notified of this order by both foremen, but after all they persuaded George Avery to himself hoist them up No. 2 on the plea that it was easier and quicker than the more roundabout way by No. 3 shaft, and accordingly they prearranged the signals. When the signal "hoist-away" came up Avery immediately turned on steam and had raised the skip some 35 or 40 feet when the first blast went off. Knowing this was dangerously close he increased the speed and the skip soon emerged—but empty. He shouted down and getting no answer ran over to No. 3 and down it to the miners there and all crossed through to No. 2. They found the two on the rock and timbers below both dead. It is clear that the accident was due to deliberate disregard of the regulations on the part of Dufresne and Terrion and to too great complaisance on the part of George Avery who exceeded his authority in yielding to the desire of the men to be hoisted.

The second accident occurred at 5.15 p.m. of 31 August, by which two men, Charles McLaughlin and Ira Derry were killed. A coroner's inquest was held on 6 September, and

the jury's finding upon oath was that the said Ira Derry and Charles McLaughlin came to their death through accidental premature explosion of dynamite while Ira Derry was tamping a hole in the rock and Charles McLaughlin assisting him preparatory to blasting. They (the jury) expressed the opinion that the deceased Ira Derry was an experienced miner and was familiar with dynamite, that the material used was a proper quality, and that the occurrence was purely accidental, no blame attaching to anyone so far as could be seen. The ages of the deceased were Ira Derry, 35 years, and Charles McLaughlin, 21 years.

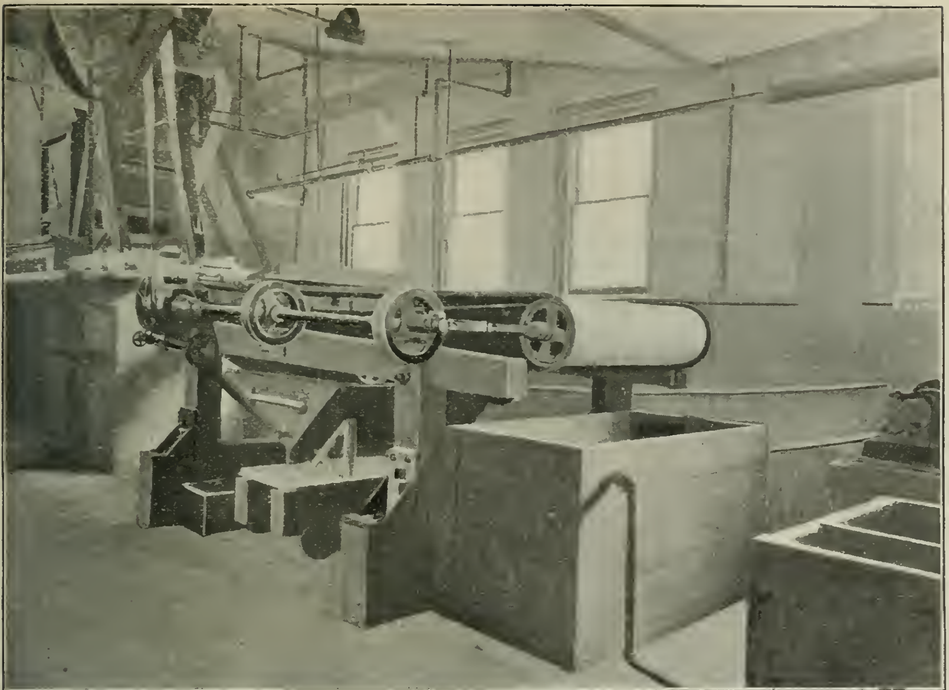
Derry was working by contract driving west the 185-foot level in No. 3 shaft and McLaughlin was his helper. There were no witnesses of the explosion and only two men are familiar with the antecedent circumstances, Thomas Fisher, foreman of No. 2 and 3 shafts, and Jerry Legrow, miner. According to these men the whole face was drilled ready to be blasted at 5.45 that evening and Derry, after a trip out for powder, had returned again to the drift to load. Within five minutes the explosion occurred. Fisher and Legrow thinking from its prematureness that it must be an accident went to the entrance and after turning on the air blast ran into the drift and found both men, lying one across the other, about eight feet from the face and terribly cut up by the rock, Derry still breathing and McLaughlin dead. The former, however, expired shortly after.

It appears that Derry was loading his first hole, an old one which had only partly broken the day before, and it is thought that the primer was pressed too hard by the tamping stick, causing the explosion. There is no evidence that anything else was wrong.

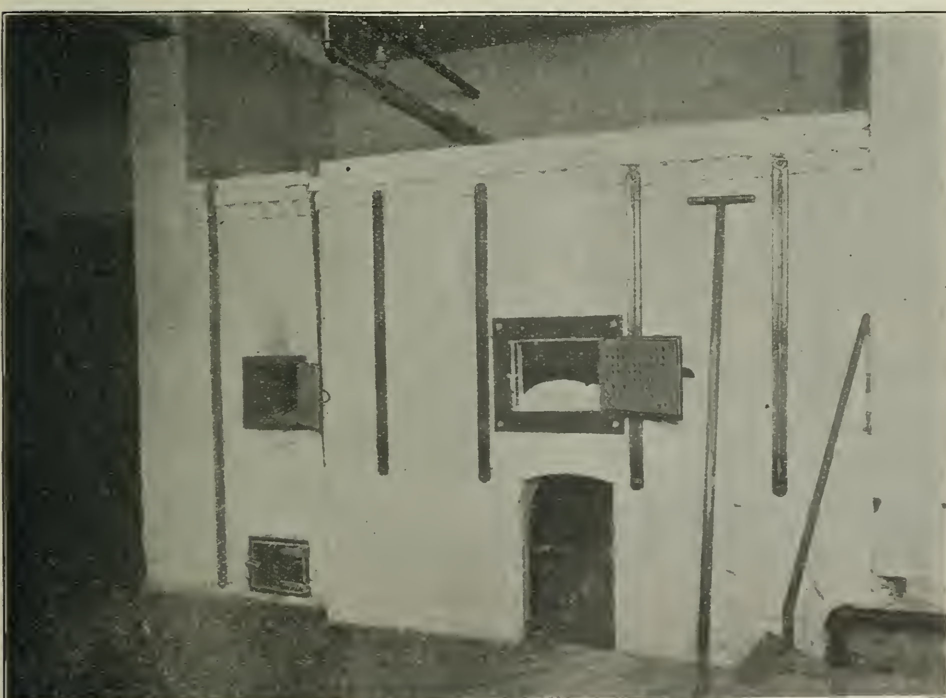
The third accident had nothing to do with the mine itself but having occurred during construction work on the surface plant it is here included. Two men were involved, one being only slightly hurt but the other so seriously that he died a few days later. At 3.30 p.m. on 22 November while these two, Truman McMillan and Thomas Irvine, were working on a scaffold erected by the latter and thirty feet above the ground, putting eaves on the stamp mill building, the scaffold collapsed and the men fell with it. McMillan dropped among some loose boards and received next to no injury, but Irvine lit with his head against an iron plate and it was severely cut and fractured. A doctor was attending him within an hour and advised his removal to the Kingston hospital to which place he was sent by the midnight train. Three days later he died there. McMillan returned to work again in four days.

At the Birch Lake Mica Mine.

At this mine in Loughboro township, Frontenac county, on 10 April an explosion occurred in a pit by which four men, George F. Amey, William Green, George E. Jeffery and Peter Quigley were more or less seriously injured, the first named losing the sight of both eyes. It was just before 6 p.m. and blasting time when the foreman of the above gang, Quigley, brought over to the pit a stick of dualin, cut it in two and stuck the cap and fuse into one end, but as the hole to be blasted was not yet quite deep enough he laid the charge in its dangerous condition at the edge of the pit. Returning after five minutes, he decided to load the hole, and apparently forgetting about the previously prepared stick brought another and started to fix a cap and fuse in it, afterwards loading and blasting the hole therewith. Jeffery was then told by Quigley to clear away the stones from the mouth of the pit, and in so doing thinks be must have knocked the primed stick of dualin in, for though he had seen Quigley lay the first stick down by the pit mouth and also load the hole with another he did not mention it at the time, and indeed forgot about it until after the accident. He is certain Quigley did not remove it. By this time Amey, Green and Quigley were in the pit and Jeffery having cleared away the stones followed. Amey began picking down the walls about the blast, and must have struck the stick of dualin for there was a sudden explosion which sent fragments of rock flying in all directions blinding and cutting Amey, cutting Quigley's neck badly, breaking a cord in Green's leg as he



Stamp Mill, School of Practical Science, Toronto.



 Roasting Furnace, School of Practical Science, Toronto.

Queen's University and School of Mining, Kingston.

School of Mining, Kingston ; Putting in Mortar Block for Stamp Mill.

was climbing at the moment out of the pit, and generally bruising and shaking up Jeffery. Amey never recovered his sight and Green was unable to work for a month, while Jeffery's and Quigley's injuries were soon mended.

It would appear from the evidence of Jeffery and Amey that Quigley was careless in handling powder at all times owing to ignorance of its properties. Quigley and Green could not be found at the time of the investigation by Inspector De Kalb, but later when a claim for damages was brought in the law courts at Napanee the verdict rendered by the jury entirely acquitted Quigley of negligence.

Manual of Explosives.

As the following table shows, one-half the accidents and one-half the deaths in 1900 were due to the explosion of dynamite or other similar substance, the record for the year being in this particular even more grievous than that of 1899, which was commented on in the last report. It is quite evident that much ignorance obtains among the miners of the Province respecting the proper use of these dangerous materials, though it is doubtful whether after all ignorance is more to be dreaded as a possible source of accident than the contempt engendered by familiarity. In order, however, to educate the mining community in the safe and economical handling of explosives and to reduce if possible the number of casualties annually occurring through the neglect of proper precautions in their use, Mr. Courtenay De Kalb, Inspector of Mines for Eastern Ontario and Professor of Mining and Metallurgy in the School of Mining at Kingston, was requested by the late Director of the Bureau, Mr. A. Blue, to prepare a brief handbook describing the nature of the explosives more commonly in use and the proper safeguards to be observed in their employment. Mr. De Kalb was well fitted by his experience as a mining engineer and operator to deal in a practical way with the subject, and he was further equipped for the task by visiting and inspecting a number of factories in the United States and Canada where explosives are made. The result of his labors was the Manual of Explosives, a book of 126 pages, in which the subject is dealt with under the following headings : Common Explosives ; Fuse, Caps and Methods of Firing ; Theory of Explosives and Fumes ; Transportation, Storage and Handling ; Blasting.

The volume has been well spoken of both by scientific and practical men, and there can be no doubt that if the directions it contains are faithfully observed the number of accidents resulting from the misuse of explosives will materially diminish. In order that it might have the widest circulation among those for whose benefit it was prepared, all the mining companies actually at work in the Province were asked to furnish a list of their captains, foremen or employes handling explosives and a copy was mailed to each man whose name was given, as well as to every known mine manager. Persons operating quarries, contractors and foremen engaged in railway construction and others whose occupations involved the handling of explosive substances have also been made welcome to a copy. It is sincerely to be hoped that the publication of this manual will mark the beginning of a better condition of affairs in the mines of the Province so far as accidents due to explosives are concerned. There has been a considerable demand for the book from other Provinces of Canada and from the United States, the price to persons living outside of Ontario being 25 cents.

MINING ACCIDENTS, 1900.

No.	Date.	Mine.	Name of person.	Result of injury. Slight.	Serious.	Fatal.	Above ground.	Below ground.	Nature of injury.	Cause of accident.
1..	January 1	Sultana	John Olson	....	....	1	....	1	Killed	Explosion of dynamite.
			Charles Tonstron	....	....	1	....	1		
2..	February 2	Copper Cliff	James McGregor	....	1	....	1	....	Bruised back	Struck by flying rock from blast.
3..	" 12	John Sykes	Joseph Greenwood	....	....	1	....	1	Killed	Drilled into dynamite, exploding it.
			Frank Potvin	....	....	1	....	1		
4..	April 10	Birch Lake	George Amey	....	1	....	....	1	Blinded in both eyes	Explosion of loose powder in the muck.
			William Green	....	1	....	....	1	Cord in leg broken	
			George E. Jeffery	1	...	....	....	1	Bruised	
			Peter Quigley	1	...	....	...	1	Several cuts in neck	
5..	" 14	Golden Star	Frank Anderson	....	1	....	....	1	Broken leg	Fell down stope.
6..	" 17	Copper Cliff	William Thompson	....	1	....	....	1	Face lacerated, eyes injured	Struck by rock blast.
7..	May 29	"	Joseph Ruble	....	....	1	1	....	Died after 12 hours	Caught under sliding rock.
8..	June 8	Foley	Peter McEachern	....	1	....	1	...	Compound fracture of wrist	Fell off waggon.
9..	" 9	Victoria	John Donnelly	....	....	1	....	1	Killed	Struck by falling timber.
			John French	....	...	1	....	1		
10..	July 10	Copper Cliff	Samuel Hogue	...	....	1	1	...	Died after 2 days	Struck by flying rock from blast.
11..	" 12	Mikado	John McGuire	....	1	....	....	1	Arm and leg broken	Fell down winze.
12..	" 21	Sultana	August Anderson	....	1	....	1	....	Cut about body	Explosion of powder thawing-can from loose nitro glycerine.
			Adolph Hedlund	....	....	1	1	....	Killed	
13..	" 24	Belmont	Louis Defresne	....	....	1	....	1	Killed	Fell out of ascending skip.
			Peter Terrion	....	.	1	....	1		
14..	August 13	Copper Cliff	Elias Knopiala	....	1	....	1	....	Head cut	Struck by rock blast.
15..	" 27	"	James Beatty	....	...	1	1	....	Killed	Run over by railroad car.
16..	" 31	Belmont	Ira Derry	....	....	1	....	1	Killed	Premature explosion.
			Charles McLaughlin	....	....	1	....	1		
17..	September 4	Copper Cliff	Gus Johnson	....	...	1	....	1	Died in 2 days	Struck by rock blast.
			John Kutjee	1	....	...	....	1	Bruised	
18..	" 26	"	Antonio Garafala	....	....	1	1	....	Died in 2 hours	Run over by ore train.
19..	October 30	Helen	John Bishop	....	1	....	....	1	Leg broken	Struck by rolling rock.
20..	November 22	Belmont	Thomas Irvine	....	...	1	1	....	Killed	Scaffold collapsed.
			Truman McMillan	1	...	....	1	....	Bruised	
			Totals	4	10	17	11	20	Total number	of casualties, 31.

WORK WITH THE DIAMOND DRILL

In the Bureau's Report for 1895 a description was given of the Sullivan diamond drill purchased by the Bureau in 1894 under authority of the Act passed by the Legislature that year, and several pages were devoted to an account of the work done by the drill up to 23 October, 1895. After completing operations at the Mammoth gold mine, owned by the Bonanza Nickel Mining Company, on the last-mentioned date, the drill remained idle for over a year, no application for its services having been received.

ANTHRAXOLITE IN ALGOMA.

In June 1896 discovery was made on lot 10 in the first concession of the township of Balfour in the district of Algoma of a deposit of mineral claimed by the owners to be anthracite coal, but classed by mineralogists as "anthraxolite." The finding of this deposit naturally excited much interest in a coalless country like Ontario, and gave rise on the part of some to a hope that an important source of coal, or at any rate mineral fuel of useful quality, would be made available. The possibility of such a supply seemed to warrant the Bureau in taking steps to set the matter at rest; and with this end in view the diamond drill was placed at the disposal of the parties interested in the mine, the object being to ascertain whether the mineral possessed good fuel properties and whether the deposit was large enough to constitute the basis of a commercial enterprise. In December 1896 instructions were given Mr. W. W. Roche, then mechanical manager of the drill, to have the plant transported to Balfour and to begin operations under the directions of Mr. J. R. Gordon, C. E., whom the owners of the property had engaged to supervise the work. Some difficulties were experienced in getting the machinery on the spot, but on 12 February drilling began in black fissile slate about 100 feet south of the outcropping of anthraxolite. At a depth of 229 feet the vein of anthraxolite was struck and the cores showed that about four feet of the mineral was passed through. The hole was finished in slate at a depth of 260 feet. This work seemed to prove the continuity of the vein to a depth of upwards of 100 feet from the surface, and it was thought sufficient had been done in the interest of the government or the public, and that the further development of the property might safely be left to the owners. It may be added that tests of the anthraxolite made under the boiler of the diamond drill showed that it burned well with a brillant blue flame and great heat. The proportion of waste or ash was very great, however, amounting to nearly one-half. As the deposit has not yet been opened on a large scale its value as a source of fuel supply is still undemonstrated.

McGOWN MINE IN FOLEY

In March 1897 application was made for use of the drill by the McGown Gold Mining Company of Parry Sound to explore lots 146 and A in concession B of the township of Foley, upon which gold and copper had been found in 1894, and which as the result of a small amount of development work had given promise of becoming a valuable mine, especially for copper. It was at first believed that gold would be the principal mineral, as a number of small nuggets were found in the decomposed material on the surface of the vein, and gold was also visible in the quartz of the vein itself. Further examination showed that copper ore, including the richer sulphides like chalcocite and bornite, as well as ordinary chalcopyrite, was present in quantity sufficient to determine the mine as one of copper. The country rock enclosing the vein was a gray, slightly schistose rock resembling diorite, or diorite schist. As to the vein matter, it carried quartz and portions of intermixed wall rock, together with a brownish, fine-grained material composed of quartz, confusedly disposed muscovite, and brown and red garnet. The drill was ordered upon the property, and actual boring began on 3 May, finishing on 28 June. Three holes were put down, No. 1 to a depth of 40 feet, No. 2 to 105 feet, and No. 3 to 145 feet—290 feet in all. Drilling was mainly in the diorite schist—or "granite" as it was classed by the manager of the drill in his reports—and vein matter. Details as to rate and cost of the boring are given in the schedules below.

The Deloro Gold Mine.

Immediately upon completion of the work at the McGown mine the drilling plant was placed at the service of the Canadian Goldfields, Limited, who had some little time previously acquired the gold mines at Deloro in the county of Hastings, and who were desirous of defining more closely the extent and dimensions of their ore bodies. The property had been worked a number of years before by the Canada Consolidated Gold Mining Company, but the mispickel ore proved refractory, and the roasting furnaces and chlorination plant failed to yield satisfactory results. The Canadian Goldfields believed that the Sulman-Teed process, in which a solution of bromo-cyanogen is employed to leach out the finely disseminated gold from the powdered ore, was specially adapted for use on this property, and had erected a mill and installed a plant to put this process in operation. The drill began to run 21 July and stopped work 13 September following. Two holes were put down, the first to a depth of 300 feet, and the second to a depth of 347 feet. Particulars as to cost will be found in the schedules given below. Up to the time the drill was shipped from the McGown mine it had been under the management of Mr. W. W. Roche, upon whose resignation Mr. Henry Cossette, a driller of much experience was appointed to the position.

In Lutterworth Township.

From Deloro the drill was sent to lot 5 in the sixth concession of Lutterworth, a property owned by the Ontario Bank and thought to contain iron ore. Work began on 9 October and finished 21st of the same month. One hole only was sunk, the depth being 149 feet.

Location J C 66

The next property upon which drilling operations were undertaken was Mining Location J C 66, held under mining lease by Nassau Brown Eagen of Toronto, barrister, and associates, and situated on the south shore of Long lake, east of Lake of the Woods, some nine or ten miles from Rat Portage. A large showing of quartz was found on this location, and it was desired to ascertain its extent and value. The drill reached the property 23 December, 1897, and drilling began 1 January, 1898, finishing 24 January. Mr. Roche was again in charge. The cost of drilling on this property was much in excess of that on any other in the list. The figures are omitted as they would be misleading for purposes of comparison. Several causes contributed to this result. The drill had to be forwarded by rail from Kinmount station to Rat Portage, a journey of more than 1,000 miles, and the freight charges and travelling expenses were consequently very heavy. Great difficulty was experienced in hauling the drill from Rat Portage to Long Lake, the season being the height of winter and the snow lying deep on the ground. The rock proved excessively hard and the wear of diamonds was unusually great. The amount of boring done was small, hence the charges for freight, travelling expenses, haulage, etc., which would have been no more had five or ten times the number of feet been bored, ran the cost up to a high figure per foot on the amount of work actually done. Mr. Roche resigned from the Department's service on the conclusion of this work, and Mr. L. A. Oyster, a skilled drill runner, was appointed in his stead.

Locations D 219, D 220 and D 221.

On concluding work at J C 66 the drill was moved to Mining Locations D 219, D 220 and D 221, three small islands in Bag bay of Shoal lake, west of Lake of the Woods, which were patented in November, 1896, to J. Emmons, H. Langford and M. Kyle. Promising quartz veins, thought to be a continuation of those of the well known Mikado mine, which lies about 300 ya to the southeast, had been located on these islands, and operations were begun on

Island D 221, where three holes were put down to a depth respectively of 84, 190 and 134 feet. The drill was then placed on D 219 where two holes were sunk, 176 and 129 feet deep respectively. The rock material encountered by the drill was hard, but the expense was kept within moderate limits, the amount of boring done, 713 feet, being sufficient to give a fair average basis of cost. The cores brought up by the drill demonstrated in the opinion of the owners that the Mikado veins cross this property. According to information furnished by them, bore hole No. 1, which was located close to the southwest corner of D 221, struck an extension of Mikado No. 1 vein at a vertical depth of 120 feet, and found it to have a width of 11 feet from wall to wall. After passing through 24 feet of granite in the same hole the drill penetrated three small veins of quartz enclosed in bands of altered silicified country rock. Assays from the first vein averaged $19 per ton. In the second bore hole the drill went through eleven distinct sheets of quartz, of which seven with a total width of 19 feet, formed one group within a space of 60 feet, the average assay value being $67.45. Separated by 46 feet of granite from the first group, another series of four quartz sheets was encountered within a space of 42 feet, the first two of which were 12½ feet wide and including the 10 feet of silicified material between them, gave an average assay value of $57.65 per ton. Bore hole No. 3 revealed two distinct and compact quartz bodies, the first one at a depth of 42 feet being 26 feet wide, showing an average value of $6.70 ; and the second one at a depth of 120 feet being 6½ feet wide with an average value of $16.50.

Murray Nickel Mine.

The Murray nickel mine on lot 11, in the fifth concession of the township of McKim, was actively worked for several years by Messrs. H. H. Vivian and Company of Swansea, Wales, but operations were suspended in 1894. Messrs. Vivian and Company having in view the reopening of the mine and being desirous of exploring their ore bodies as a preliminary step, the diamond drill was engaged by them and was moved from Rat Portage to the property in November, 1898. Boring was begun on 2nd December, 1898, and the work continued until 16th June, 1899, the number of days' actual boring being 212 of 10 hours each. For the greater portion of the time night and day shifts were employed. In all eight holes were put down, having an aggregate depth of 1,146 feet, on various outcroppings of mineral on the Murray and Violet properties. Most of the drilling was in diorite, always hard and frequently broken, the remainder being in diabase, vein matter and ore.

McConnell Nickel Location.

The drill was then placed on a nickel-copper property owned by Mr. Rinaldo McConnell in the township of Denison, where it remained at work from 10 July to 21 November, 1899. Seven holes were bored, the aggregate number of feet being 994. The rocks penetrated were diorite, very hard and for the most part shattered and broken, quartz and vein matter. Before the drilling was completed, the location was sold to Dr. Ludwig Mond of London, England, but the operation of the drill was not affected by the change, and the figures given in the tables below cover the work done for both owners.

After finishing in Denison the drill was removed to the iron ore locations of the Mattawin Iron Company on the range of that name west of lake Superior, where it has remained steadily at work ever since.

The demand for the use of the drill being greater than could be supplied by one machine, the Department under the authority conferred upon it by the Mines Act, purchased a second drill from the Sullivan Machinery Company of Chicago. It is size "S," considerably smaller and lighter than size "C," the one already owned, and capable of boring about 500 feet in

depth, the diameter of the core taken out being fifteen-sixteenths of an inch. The price paid for the drill proper was $1,428,85, with duty $27.75 in addition. A boiler purchased from E. Leonard and Sons of London for $270, and a Northey pump for $75 completed the outfit, which has proven a handy and useful one, costing less to operate and move from place to place than the larger machine, and with a boring capacity sufficient for the majority of cases. It was at once placed at the disposal of the British Colonial Mining and Development Company to prospect the Katherine lead and zinc mine near Millbridge in Hastings county. Mr. W. J. Trethewey was put in charge of the plant, but resigned towards the close of the year, and was succeeded by Mr. Oscar R. Smith.

A noteworthy feature in 1900 was the sudden increase in the price of black diamonds, which rose from $39 per carat in February to $65 per carat in June. It fell again to $52 per carat early in 1901. In 1894 when the Bureau's first drill was bought, the price of diamonds was $16 or $17 per carat only. As loss of diamonds is one of the chief items of cost in diamond drill boring, the increase has added materially to the expense of the work. The drills, however, remain in unabated demand.

Comparative Results.

The operations of the drill on the several properties have been tabulated below. Reference to table will show a comparatively narrow range of expenditure. The lowest cost per foot was at the Canadian Goldfields mine, where the mica schists and crystalline limestone afforded comparatively easy drilling. The average rate of progress per day was also greatest on this property. The most expensive operations per foot of drilling were those on J C 66 on Long Lake. The causes of this unusual expense have already been enumerated. The number of feet bored per day was lowest on D 219, 220 and 221, but is closely approximated by that at the Murray and Violet mines of Messrs H. H. Vivian and Company and at the McConnell location. The tough granites and quartzites of the Lake of the Woods district are quite as difficult to penetrate as the dense, shattered diorites of the Sudbury region. In broken ground the drill runner must exercise great care lest he break or lose his diamonds, and is also hampered by the occasional disappearance of the water through a seam or fissure at the bottom of the hole.

As will be seen from the tables the total cost of boring 3,939 feet was $9,621.35, or an average per foot of $2.44. Of the cost $6,072.22 was charged to the owners of the properties, and $3,549.13 assumed by the Bureau of Mines, the Regulations providing that 45 per cent of the cost should be so assumed up to the end of 1897, when the Bureau's share fell to 35 per cent. The average cost of the whole of the operations to the property-owners was $1.54 per foot.

Briefly, the conditions upon which the services of a Government diamond drill may be obtained are as follows : A bond must be given with sufficient sureties in an adequate amount or other security to the satisfaction of the Commissioner of Crown Lands for payment of the cost incurred in operating the drill, including freight charges, cost of superintendence, labor, fuel, water, repairs, loss of diamonds, wear and tear, etc. An additional charge of $50 per month is provided for where the drill is retained in use after it has shown the property on which it is working to be valuable. Thirty-five per cent. of the cost is assumed by the Bureau of Mines, and monthly settlements are required from the person or company using the drill. The mechanical manager is appointed by the Government, and is required to make weekly reports of the progress of work, the strata pierced, etc., as well as a detailed report on the operations when finished. He must also give a bond for the faithful performance of his duties, and is forbidden to impart any information respecting the borings or exhibit the cores or cuttings to anyone except the Director of the Bureau of Mines or the person or company for whom the drilling is being done.

Drilling in Australia.

In 1899 the diamond drill operated by the Department of Mines and Agriculture, New South Wales, put down holes to an aggregate depth of 1,573 feet 8 inches at a cost per foot of 23 shillings $2\frac{3}{16}$ pence, or say $5.61 per foot, of which the diamonds used cost 6 shillings $3\frac{3}{16}$ pence or $1.52 per foot.

The Government of Victoria have gone very extensively into the business of assisting the development of the gold and coal fields of that colony by means of boring by drills. They began in 1877 with three drills and now have fifteen drills in use including several of the "calyx" type, the whole having a value of £30,000. Up to the present about £370,000 has been expended in the purchase of plant and diamonds and in boring, the total depth bored being about 720,000 feet. In boring for the deep alluvial leads overlain with basalt, which are characteristic of Victoria, the diamond drill is preferred, the average cost being estimated at from 7 shillings 6 pence to 12 shillings per foot; for boring in the coal measures with a calyx drill the cost varies somewhat with the depth bored, averaging about 5 shillings per foot down to 1,000 feet. In some instances this work has been done at the low cost of 1 shilling 8 pence per foot, but in such cases the strata were of medium hardness.

In the "calyx" drill "the principle is practically the same as in diamond drilling, viz., cutting points attached to the end of rotating tubes. In this class of boring, the speed of periphery of bit is reduced considerably, being from 5 ft. to 12 ft. per minute, while the pressure on bit is increased; the harder the rock to be bored, the greater the pressure, with a proportionately slower speed. The following explanation is offered as to the method in which the bit performs its work :—On the bit reaching the bottom of hole, a pressure suitable to the class of rock to be bored is put on rods, varying from 500 to 3,000 lbs.; this causes the teeth of bit to bury their points in the rock and remain stationary until sufficient rotary energy has been given to the rods to wedge away the particles of rock in front of bit teeth; but before the bit has commenced its revolution, the periphery of the top of rods will have travelled from a quarter to one inch, and this torsion in the rods, which represents stored-up energy, causes a series of rapid cutting blows to be given by the teeth of bit. In all classes of rock, from sandstone to basalt, this chipping action of the bit teeth can be seen in the cores."[6]

"Calyx" bits can be used on the diamond drill plant or may be used with much lighter machinery and driven by horse power.

So far the calyx drill has not been used much in Canada or the United States. Borings made at Niagara Falls by the Canadian Niagara Power Company are said to have resulted satisfactorily, furnishing a complete core having a diameter of three inches.

Another variety of drill is one which has as its cutting device a soft iron pipe revolving at the rate of 100 to 120 revolutions per minute on chilled steel shot which are fed in at the surface and dropping into the bottom perform their office of cutting away the rock under the heavy and rapidly revolving pipe on the same principle as sand cuts into marble under a toothless was. This is the Beal prospecting core drill, manufactnred in Elyria, Ohio. It is alleged to be capable of good work, especially for cores of large diameter, and in rocks of moderate hardness.

6 Stanley Hunter in Transactions of the Australasian Institute of Mining Engineers, Volume 7, 1901, page 47.

Statement showing Details of Cost and Rate of Drilling on the several Properties.

Mine.	Mineral.	Feet drilled.	Freight and travelling expenses.	Labor and teaming.	Wood.	Lumber and drill supplies.	Renewals and repairs.	Diamonds.	Fireman.	Superintendent.	Total cost of work.	No. of days actual drilling (10 hours).	Average No. of feet drilled per day (10 hours)	Rock drilled.
			$	$	$	$	$	$	$	$	$		ft. in.	
McGown	Copper	290	113 40	87 55	25 43	17 16	31 00	117 93	63 58	151 02	607 07	23	12 7	Granite, quartzite, quartz, vein matter.
Canadian Gold Fields...	Gold	647	110 75	113 69	55 50	29 88	57 85	133 40	105 40	288 41	894 88	44	14 8	Micaceous rock, limestone, quartz, granite, mispickel.
Ontario Bank	Iron	149	49 45	40 75	12 00	13 88	28 00	48 09	33 70	89 83	315 70	11	13 6	Granite.
D 219, 220, 221.........	Gold	713	59 95	471 00	*a*	52 89	112 48	255 24	217 05	650 42	1,819 03	140	5 1	Granite, quartzite, vein matter.
H. H. Vivian & Co.	Nickel ...	1,146	228 32	598 01	*a*	103 07	174 10	393 94	377 23	1,172 78	3,047 45	212	5 5	Diorite, diabase, vein matter.
R. McConnell	Nickel	994	25 68	384 52	*a*	42 46	50 00	542 02	195 08	502 09	1,741 78	178	5 7	Diorite, quartz, vein matter.
	Total....	3,939	845 55	1,981 92	92 93	333 22	483 43	1,794 05	1,067 95	3,006 38	9,621 35	628	....	
Average per foot........		.... .	0.214	0.503	0.086 *b*	0.084	0.122	0.455	0.271	0 763	2.44	. ...	6 3	

a Included in Labor and Teaming. *b* Average of first three properties.

Statement showing Cost of the Various Services per Foot Drilled.

Service.	McGown.	Canadian Goldfields.	Ontario Bank.	D 219, 220, 221.	H. H. Vivian & Co.	R. McConnell.
	$	$	$	$	$	$
Freight and Travelling Expenses	0.391	0.171	0.332	0.084	0.199	0.026
Labor and Teaming..............	0.302	0.176	0.273	} 0.661	0.521	0.387
Wood..............	0.088	0.086	0.080			
Lumber and Drill Supplies..............	0.059	0.046	0.093	0.074	0.090	0.042
Renewals and Repairs	0.106	0.089	0.188	0.158	0.151	0.050
Diamonds..............	0.407	0.206	0.323	0.358	0.344	0.546
Fireman	0.219	0.162	0.226	0.304	0.329	0.196
Superintendent	0.521	0.446	0.603	0.912	1.023	0.505
Total	2.093	1.382	2.118	2.551	2.657	1.752

MINING SCHOOLS IN ONTARIO.

Intimately associated with the progress of the mining industry are the means provided for the education and training of mining engineers. The favorable issue of a venture depends so largely upon the skill and intelligence with which it is conducted that the wonder is to find men at any time willing to risk their money in the hands of incompetent and inexperienced superintendents. Yet it is often the case that large sums are laid out by men who have little or no knowledge, either practical or theoretical, of mining or mining affairs. The lack of qualified engineers educated in native schools and trained to the peculiar problems presented by the mineral conditions of the Province has operated in the past as a serious hindrance to the industry. The agencies now at work in the mining schools at Toronto and Kingston bid fair to reduce this drawback to a minimum if not to abolish it altogether, and to provide from the youth of Ontario a body of skilled engineers for the exploitation of Ontario's mineral resources. The rate at which the mining industry is expanding and the excellent prospects before it are drawing into the mining classes of these institutions increasing numbers of students, and in view of this a short description of the School of Practical Science, Toronto, and the School of Mining at Kingston, will not be out of place.

School of Practical Science, Toronto.

The course in mining engineering at the School of Practical Science, Toronto, is designed to give the student of mining engineering a preliminary training which will be of use to him afterwards in carrying out the extremely complex duties which he may be called on to perform. All efforts are directed towards giving the student a useful foundation on which he must himself build by observation and practical work. The time at the school is therefore spent on subjects which can be learned better there than in outside practice.

Degrees in engineering are not granted by the school to students on the termination of their course, but are only obtainable by graduates of the school from the University of Toronto, of which the school forms the Faculty of Applied Science, after spending three years in the actual practice of their profession and fulfilling certain other conditions.

The course in mining engineering as finally settled upon by older schools having the advantage of long experience—an experience with some extending over a hundred years—embraces many subjects common to both civil and mechanical engineering, the amount of time in the course spent on subjects which belong more particularly to mining and metallurgy averaging about 50 per cent. of the total time in the older schools enjoying a high reputation. These subjects include chemistry, mineralogy, geology, metallurgy and mining. The success of the graduates of these older schools in practical work for some generations proves that a preliminary training such as can be given in a school is of value, and gives those who have it an advantage over others of equal ability and industry. The expensive equipment required to train civil and mechanical engineers must necessarily form an essential part of the equipment in a mining school.

In the School of Practical Science the course is a three years' one leading to the diploma with the privilege of taking a fourth year and obtaining the degree of Bachelor of Applied Science (B. A. Sc.). The courses which are practically the same in the first year, gradually differ more and more. In the first year the course in mining takes up mathematics, drawing, chemistry, mineralogy, physics, mechanics, and surveying exactly as in civil engineering and nearly the same as in mechanical engineering. In the second year the mathematics vary

slightly from those in civil engineering; drawing, chemistry, metallurgy and physics are the same, and there are some differences in mineralogy and geology, engineering and surveying.

In the third year the difference in the courses becomes considerable, each of the courses taking work peculiar to itself. The purpose of the fourth year is to give the student an opportunity to carry out more extended work in the various laboratories. The work is almost entirely practical and varies greatly in the different departments, students even in the same department devoting a large part of their time to some special study or investigation selected by themselves.

In addition to the work done in the school all students are required to do a certain amount of work in the vacation, and to show that they are cultivating their powers of observation by studying whatever outside engineering work they have the opportunity of seeing or being employed at.

The illustrations given show part of the equipment at the School common to all the branches of engineering, and part of that which is peculiar to mining.

The principal of the school is Professor Galbraith, and the Secretary A. T. Laing.

The Kingston School of Mining.

The School of Mining at Kingston has been regularly aided by the Ontario legislature, which has annually appropriated sums to assist in its maintenance, and made special grants for construction and machinery. At the session of 1900 a special grant was made of $5,700 for the reconstruction of the milling laboratory of the school, and an annual sum of $500 for an engineer and assistant in the laboratory. In addition $2000 was granted to be applied in the payment of annual rental of a new building to accommodate the departments of geology, minerology, and general engineering. The funds for the construction of this new building have been secured and ground will be broken in the spring of 1901. The milling laboratory, however, was enlarged during the summer of 1900, and the equipment has been installed during the academic year of 1900-1901. The grant thus obtained from the Ontario Government has enabled very substantial improvements to be made, which will largely increase the usefulness of the school, not only as regards the superior training which it can give to students, but also in the direct service it can render to the mineral industry in the practical testing of ores. The School of Mining has contributed materially in this way to the advancement of practical mining in Canada in the past, and its increased facilities will henceforward permit of its doing more in the same direction. These tests are made for parties in Canada at prices intended merely to insure the covering of the costs to the school in conducting them. It should also be known that both the Grand Trunk and Canadian Pacific Railways forward ores for testing in the laboratory of the School of Mining at half rate, prepaid. The tests which can be conducted at this laboratory are ordinary milling of gold ores, cyaniding and chlorinating of gold ores or concentrates, concentration of gold, copper, lead and other ores and minerals, where such processes are applicable. The staff of the school undertake to make such tests and determine the proper process or method of treatment which will yield the highest economic results in practical operation.

In order to secure results which may be duplicated in working on a large scale it has been necessary to abandon small sized machines, or laboratory models. Accordingly the new equipment consists entirely of standard sizes of machines in all cases.

There is a material advantage also in equipping a laboratory in this manner since the students not only acquire a knowledge of the theoretic principles governing the various processes in ore dressing operations, but may be drilled in the use of the machines which they will encounter later on in practice; and they thus secure a knowledge of the conditions under which these machines will yield the highest efficiency. There has been much dispute among

educators as to the value of such training as will be given under the conditions here obtaining, and the last word on this subject has by no means been spoken ; but in the opinion of the head of this department there is no need of more than small laboratory table models to illustrate principles only ; whereas if any attempt is to be made to go farther and reach results similar to those obtained on a practical working scale, then these results should be obtained under exactly like conditions, otherwise they will be misleading. However this may appear to others, the policy pursued at the School of Mining in regard to the character of its equipment finds ample justification in the double service which it is to render in the training of students, and in the practical testing of ores as an aid to the development along right lines of certain portions of the mineral industry of Canada. It should be pointed out, furthermore, that the grant from the Ontario Government sufficed for not much more than the erection of the structure, the machinery itself being in part the gift of private individuals, many of whom are citizens of the United States, and in part purchased with moneys given for this purpose. It must also be observed that the present laboratory, while standing among the best in America for the purpose of ore dressing, includes no metallurgical equipment beyond what is involved in the processes of gold extraction, and in ordinary fire assaying. It is the hope of the authorities of the school to be enabled in the near future to make good this deficiency by the erection of a suitable fire-proof building, provided with apparatus adapted to experiments in the treatment of metals and in pyrometry, and to smelting processes so far as these can be conducted on a small scale in a laboratory.

In detail, the milling laboratory referred to is a two-story frame structure, measuring 132 feet by 67 feet on the foundations, the mill room proper measuring 98 feet by 67 feet. In the rear, on the ground floor, are the engine and boiler rooms, containing respectively a 25-h.p. Robb high-speed engine, and a 30-h.p. marine boiler. Over these rooms are the lecture room for classes in mining and metallurgy, a well-lighted draughting room, and a small chemical laboratory for chemical tests in connection with the ore testing experiments. The milling plant consists of the following : one 7 by 10-inch Blake jaw crusher ; one pair of 16-inch high-speed rolls ; one 5-stamp battery for gold ores, with 850-lb. stamps, and an automatic feeder ; one 10-inch cone grinder ; one 28-inch Krupp ball mill ; a series of inlet discharge hydraulic classifiers ; a vertical line hydraulic classifier ; a V-tube classifier for slimes ; a perforated board classifier for slimes ; one 3-compartment Spitzkasten ; one 3-compartment Hartz jig ; one 2-compartment Evans high-speed jig ; one 4-foot Frue vanner ; one standard size single-deck Wilfley table (riffle washer) ; one 16-foot modern Evans revolving buddle with cycloid water feed ; one Wetherill magnetic concentrator ; a barrel chlorination plant (350 pounds capacity at a charge) ; a cyanide plant, 1,000 lbs. capacity ; a reverberatory roasting furnace ; one Sturtevant exhauster and blower ; a German dust tower ; one Heald and Sisco centrifugal pump ; one Frenier and Son's spiral sand pump ; a Cazin water motor, 3-h.p. ; one Northey mine pump ; a gyratory screen ; a 10-inch centrifugal machine for mechanical drying, and for the treatment of slimes in the cyanide process ; one Johnson's filter press for the treatment of slimes in the cyanide process ; one 3-inch Ingersoll-Sergeant rock drill ; one 3-inch Mac Machine Co.'s balanced valve rock drill ; tripod and drifting column for the rock drills ; one 30-h.p. marine boiler ; and one 25-h.p. Robb engine. The present power plant is the same as that formerly used before the reconstruction of the mill. A central power plant is, however, to be built, supplying power to all the buildings connected with the School of Mining and Queen's University, when a 50-h.p. motor will be installed in the milling laboratory.

The building known as Science Hall has been materially improved by the installation of a new ventilating system, consisting of two fans of $1\frac{1}{2}$-h.p. each driven by electric motors, which respectively force fresh heated air through the building and exhaust the vitiated air. The steam for heating the air which is thus forced through Science Hall is derived from the boiler in the mining building.

METALLURGICAL INDUSTRIES AT SAULT STE MARIE

By Frank N. Speller

The past six years has witnessed a period of unprecedented development in metallurgical and manufacturing industries at Sault Ste. Marie. During this period the work of construction has gone ceaselessly on until now it is claimed $9,000,000 has been expended on these works, and the project is only about half completed. Cheap and abundant water power and a country abounding in the raw material of mine and forest has come into touch with the necessary capital in the hands of a master of industry, the result being the establishment of works for the utilization of this material on a scale little dreamed of a few years ago.

A short outline of the principal attempts at early development of the water power of the St. Mary river, which finally led up to the operations of the Lake Superior Power Company may not be without interest.

In 1875 or thereabouts Messrs. Laird and Henderson constructed a small water power plant and erected a grist mill on the spot where the great mills of the Sault Ste. Marie Pulp and Paper Company now stand. The property appears to have lain idle for a number of years after this firm went out of business, and in 1888 the mill and power plant were purchased by Mr. T. S. Durham, who sold it to Mr. Higgings of Marinette, Wis., for $6,000 Shortly afterwards it became the property of a local syndicate for a consideration of $30,000. This syndicate was soon incorporated as a company to develop the power, but owing to lack of confidence or lack of funds it turned the plant over to the town of Sault Ste. Marie in 1889 at cost price and the town became practically the Ontario and Sault Ste. Marie Water Light and Power Company under the laws of Ontario with an authorized capital of $400,000.

After constructing a power canal, building a little power house and paying for the land the town's funds also ran out, it having invested altogether $260,000. The ratepayers therefore gladly accepted an offer of this amount in the fall of 1894 from Messrs. F. H. Clergue and E. V. Douglas who appeared providentially, as it were, on the scene at a time when the prospect of the municipality ever getting a return for its expenditure on these works was very doubtful. Referring to this in a recent address Mr. Clergue said : "This was a period of time when my good fortune brought me to Sault Ste. Marie, where my good sense has kept me ever since."

It was arranged that these capitalists should take over the property and commence work where the town left off, contracting to erect a power plant and mills. These contracts have been fulfilled at least four-fold and gigantic enterprises are being pushed forward with a rapidity and vigor surprising to all who visit the immense works of the Lake Superior Power Company.

Calcium Sulphite for Pulpmaking.

A large mechanical pulp mill was the company's first venture, encouraged by the successful operation of which it decided to carry the process one step further and manufacture sulphite or chemical pulp. In this process wood chips are steamed under slight pressure with an acid solution of calcium sulphite whereby all resinous matter in the woody fibre is dissolved out.

The raw materials required for the manufacture of the sulphite solution, iron pyrites or pyrrhotite and limestone, are found in abundance in Algoma and other parts of the Province. Thousands of tons of sulphur are burned and lost every year in the roast beds of the Sudbury district, contaminating the atmosphere and destroying vegetation. The ease with which the requisite raw materials can be assembled, the inexhaustible supply of pure water to be obtained from Lake Superior and the great development of power possible, renders the situation at Sault Ste. Marie an ideal one for the manufacture of pulp and paper.

With the object of recovering the sulphur the finely ground pyrite or pyrrhotite is passed through a specially arranged upright roasting furnace in which the ore is kept in motion during the downward passage, being finally drawn off at the bottom "sweet."

The sulphurous acid gas from the reduction works is passed to the plant in which the calcium sulphite solution is made. This consists of eight vats, 5 feet in diameter inside and 100 feet high, constructed of 4-inch British Columbia fir. These towers are placed in a suitable building of the well-known St. Mary's sandstone standing 110 feet high. The vats are filled with calcium carbonate and dolomite, the quality of which best adapted for this purpose is found in the neighborhood.

Sulphurous acid enters at the bottom of the vats and is drawn upwards by means of a steam exhauster located at the top. A stream of water is admitted at the top of the tower vats and as it flows downward over the limestone, absorbs the ascending gas. This solution of sulphurous acid gradually dissolves the calcium carbonate (limestone) and forms calcium sulphite (sulphite liquor) which leaves the tower vats at the bottom below the gas inlet and flows to large store tanks.

The strength of this sulphite solution is regulated by the water flow; if the out-flowing liquor is found to be too strong, more water is admitted at the top; should it be too weak, the water is partially shut off.

Adjoining the calcium sulphite plant just described is the digester building, 125 feet high, containing the largest digesters yet constructed. These are tall cylinders the shells of which are made of 1¼-inch steel plates and lined with acid-proof brick to protect the steel from the action of the acid solution.

The wood is barked and cut into small chips, from which the knots and saw-dust are carefully removed by special machinery. Thus cleaned the wood chips are elevated to a large bin from which the digester can be filled in ten minutes. When the digester is full the sulphite solution is admitted from the store tank. The digester is then tightly sealed, steam is admitted at the bottom and digestion continued for ten hours, after which the cooked pulp is emptied under pressure into large "blow-off pits" where it is washed and afterwards pumped to special machinery and vats. It is here cleaned, bleached and dried for shipment.

Each of these digesters makes one "cook" every 12 hours, and in each cook 30 cords of wood are reduced to 16 or 17 tons of sulphite fibre. In this way 64 to 75 tons of sulphite pulp are manufactured every 24 hours. All the machinery is driven by electric power from the Lake Superior Power Company's works.

A 1000-h. p. steam boiler plant furnishes steam for the digesters and pulp dryers.

Ferro nickel Works.

For some time past laboratory experiments have been conducted on a large scale at the Sault with a view to utilizing the oxides of iron and nickel produced by the roasting of pyrrhotite from the Gertrude mine which carries practically no copper. These efforts have resulted favorably and a considerable quantity of the first ferro-nickel made by this process, carrying about 6 per cent. nickel, will be shown in the Ontario mining exhibit at the Buffalo Pan-American Exposition this summer.

It is claimed that by the use of a special electrical furnace these metals can be reduced and a ferro-nickel formed sufficiently free from sulphur for the finest nickel steel; in fact, the new reduction works in which this process is to be used on a large scale and which will employ 500 men, will be completed this year. The mode of treatment is kept entirely secret.

Sulphuric Acid Plant.

On account of the number of roasting furnaces and the large quantity of ore required to supply the ferro-nickel reduction works the company had to consider what use to make of the

excess sulphurous acid ($S 0_2$) produced above that required by the sulphite mill. A sulphuric acid plant was designed to use the new catalytic process. Owing to its simplicity and low cost of operation this process promises to supersede altogether the lead chamber process which has been in use for so many years, doing away with the vitriol chambers, and the nitrous fumes as oxygen carriers.

The principle of the catalytic process depends upon the fact that some substances such as finely divided platinum have the power of inducing chemical action between two substances with which they may be in contact although they themselves remain unaltered in the reaction. This operation resulting in chemical combination is known as catalysis. Thus, when the gas from the roasting furnace has been properly cleaned and dried, it is submitted under proper conditions of temperature to the action of a "contact mass," the result being a combination of sulphurous acid ($S 0_2$) with another atom of oxygen (0) giving ($S 0_3$). Platinized asbestos was adopted by Winkler, but lately Dr. Schroeder has discovered a cheaper material for this purpose "consisting of a double salt of platinum and an earthy or metallic salt soluble in water whereby the quantity of platinum required is reduced." The activity of the catalytic agent, at least so far as regards platinum, seems to vary with the surface area exposed.

Referring to the advance made in the introduction of this process of late years Mineral Industry mentions the following advantages which a catalytic plant possesses : "In the contact process the same plant which produced 50% U.S.B. acid can, with very slight modification be made to produce 95%, 96%, 97%, 98% or 99% ($H_2 S 0_4$), the actual monohydrate, any of the fuming or Nordhausen acids, or the actual anhydride, without additional labor cost, and it is evident not only that these acids which were formerly so costly, can in this way be manufactured very cheaply, but also that the saving on the capital account will be very great as it does away with the concentration plant etc."[1]

A Steelmaking Plant.

One of the many projects which the Lake Superior Power Company has on foot and which is already taking tangible shape is the establishment at Sault Ste. Marie of iron and steel works on a large scale.

The process of making iron and steel being now under scientific control and the price of labor having become more uniform, largely owing to the influence of labor-saving machinery, the suitability of any given place for producing pig iron or steel resolves itself into a question of proximity to raw material and to the market for the finished product ; or briefly stated it becomes a question of cost of haulage. Placing the cost of a ton-mile railroad haul at four-tenths of a cent Mr. A.J. Moxham, general manager of the Dominion Iron and Steel Company, Sydney, C. B., estimates that the cost of assembling the necessary raw materials for the manufacture of one ton of pig iron in Pittsburgh, Pennsylvania, is $3.25.

The coke to be used at the Sault must be brought from either the Connellsville or Punxsutawney district. This is the most important item in the cost sheet of the locality under consideration. It means an approximate haul of 210 miles by rail from Connellsville to Lorain or Cleveland, and a water haul to the Sault equivalent to 80 miles of rail haul. As it will require 1.70 tons of coke to smelt an equal quantity of ore and produce one ton of pig iron, applying Mr. Moxham's freight rate we find that it will cost about $1.97 to bring this fuel within easy reach of good ore and limestone on the north shore of Lake Superior or at the Sault ; so that it appears quite evident that the cost of assembling the necessary raw material—coke, limestone and iron ore—in the neighborhood of Sault Ste. Marie should be much less than at Pittsburgh.

At present the Bessemer steel works and rail mills are being installed with three eight-foot cupolas for melting the pig iron for conversion.

[1] Mineral Industry 1900, p 587.

The pig iron will be provided by the Midland furnaces, until the large pair of blast furnaces now being designed are completed when the "direct metal" process will be adopted.

The Bessemer plant will consist of two acid-lined convertors of five tons capacity each. The metal after being blown is handled as in the best modern practice by pouring into moulds on buggies, the ingots being stripped after standing a few minutes. The stripping is done by means of an overhead stripping crane, designed by the Wellman-Seaver Engineering Company of Cleveland. This crane is also provided with an auxiliary trolley which is used to change the ladles on the ladle crane.

The ingots are then conveyed to the pit furnaces (soaking pits) consisting of two four-hole furnaces. The ingots are drawn and charged in these furnaces by an overhead electric drawing and charging crane, designed by above-named company, which also delivers the ingots on the blooming mill tables. They are then passed through the 32-inch blooming mill, driven by a pair of 28 by 48-inch reversing engines built by the Southward Foundry and Machine Company of Philadelphia, Penn.

The blooms are then sheared to the proper length in proportion to the section of rail into which they are to be rolled, and next are conveyed to four Siemens regenerative heating furnaces.

The overhead drawing and charging crane is used in connection with these reheating furnaces for charging and drawing the blooms. This crane also delivers the bloom on rollers which run to a 23-inch rail mill driven by a 40 by 48-inch Porter and Allen engine built by the Southward Foundry and Machine Company. There are in this mill three stands of rolls; first and second roughing, and finishing rolls.

The material is handled and manipulated at the rolls by electrically driven transfer tables, designed by the Wellman-Seaver Engineering Company. This train is covered by an overhead electric travelling crane, which is used for handling rolls and spindles when changing from one section of rail to another.

After leaving the rolls the rails are run to the hot saws where they are sawn to the required lengths. They are then passed through a cambering machine and conveyed to the hot beds, where they are permitted to cool sufficiently to be finished in the cold finishing department. Here the rails are straightened, inspected and drilled, then handled by pneumatic overhead hoists and loaded on cars under cover for shipment.

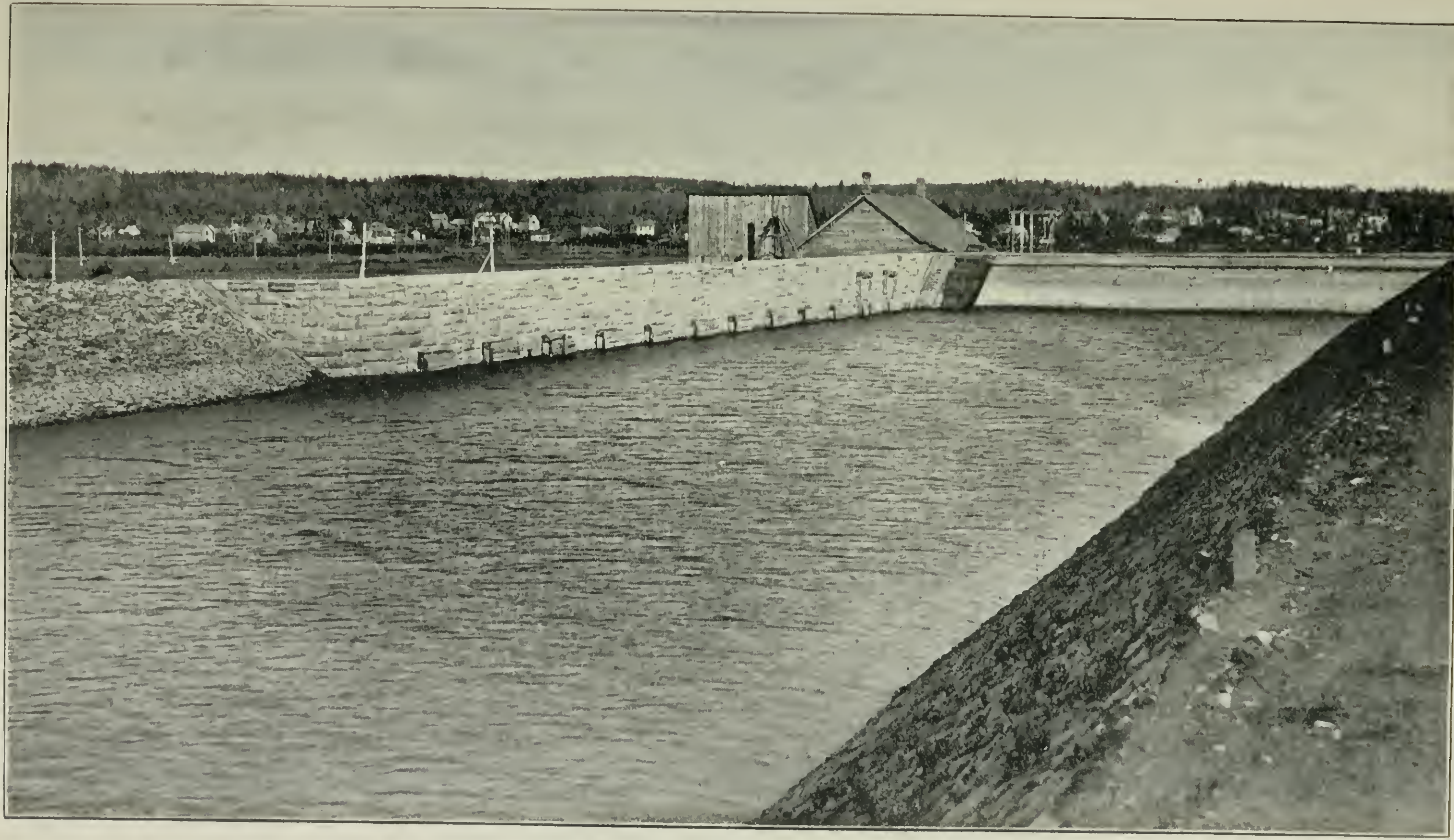
The cold finishing department being all under roof the product is carefully protected until loaded on the cars. The plant is laid out with a view to handling rails in thirty or sixty-foot lengths, up to eighty-five pounds per yard, and structural materials such as angles, channels, beams, etc.

From the above description it will be observed that where possible electricity is used to replace steam, owing to the cheapness of power in this form furnished from the water power plant of the Lake Superior Power Company. The material and product is handled throughout the works with the most approved modern labor-saving machinery. The engineering work of the plant has been entirely under the direction of the Wellman-Seaver Engineering Company of Cleveland, Ohio. The boiler plant for supplying the necessary power consists of the modern type of water tube boilers. Gaseous fuel is furnished for the soaking pits and reheating regenerative furnaces by Talbott-Fraser gas producers.

The plant is close to the terminal of the Algoma Central Railway, which affords excellent facilities for the handling of raw and finished material both by water and by rail.

All the buildings are of the artistic design adopted in other mills of this company, and built of St. Mary's sandstone with corrugated iron roofs supported on steel frames. The main

Old Power Channel at Sault Ste. Marie: View from the West; October 1894.



[8]

Old Power Channel at Sault Ste. Marie, showing Power House; October 1894.

[9] Old Power Plant at Sault Ste. Marie: North side of Penstock Wall, with Power House; October 1894.

Michipicoton Harbor, Lake Superior.

building covers a continuous space of over a quarter of a mile. A large order for steel rails to be used on the Intercolonial Railway has been given to the company by the Dominion government.

Alkali Works

The Canadian Electro-Chemical Company, Limited, of Sault Ste. Marie, Ontario, completed its plant for the manufacture of caustic soda and bleaching powder this spring and thereby added another growing industry to the locality. The raw material required occurs in abundance underlying considerable areas in the western part of the Erie and Huron Peninsula, the salt formation being found near the base of the Onondaga series. The process employed is an electrolytical one using a mercury cathode.

As is well known, all electrolytical processes for the manufacture of caustic soda and bleaching powder depend upon the fact that if two electrodes are placed in a solution of salt and an electric current made to pass between them the salt (sodium chloride) is decomposed, the chlorine passing off at the anode, while the sodium collects at the cathode. Simple as this process may appear, its practical operation is beset with many difficulties, among the principal ones being, first, the difficulty of isolating the products of electrolysis so as to prevent chemical reactions, which cause loss of electrical energy and a contamination of the electrolyte, and secondly, the question of producing large quantities of chemicals by a plant that is not unwieldy and at a reasonable cost, with a low charge for maintenance and repairs.

To accomplish these ends various means have been suggested and tried. We may divide the more important methods employed into two classes, namely, those in which some form of porous diaphragm is used with the object of mechanically separating the electrolyte from the alkaline solution whilst allowing the current to pass ; and those employing mercury as a cathode.

The system to be described belongs to the latter class. The sodium is thrown down on a thin layer of mercury (the negative pole) with which it immediately forms an amalgam, which is continually removed mechanically and brought into contact with water in another compartment. Here a double decomposition occurs resulting in the formation of caustic soda (sodium hydrate), and the liberation of hydrogen and mercury, the latter being used over again. At the same time chlorine is given off at the anode (the positive pole) and is conveyed as described below to the lead chambers containing lime.

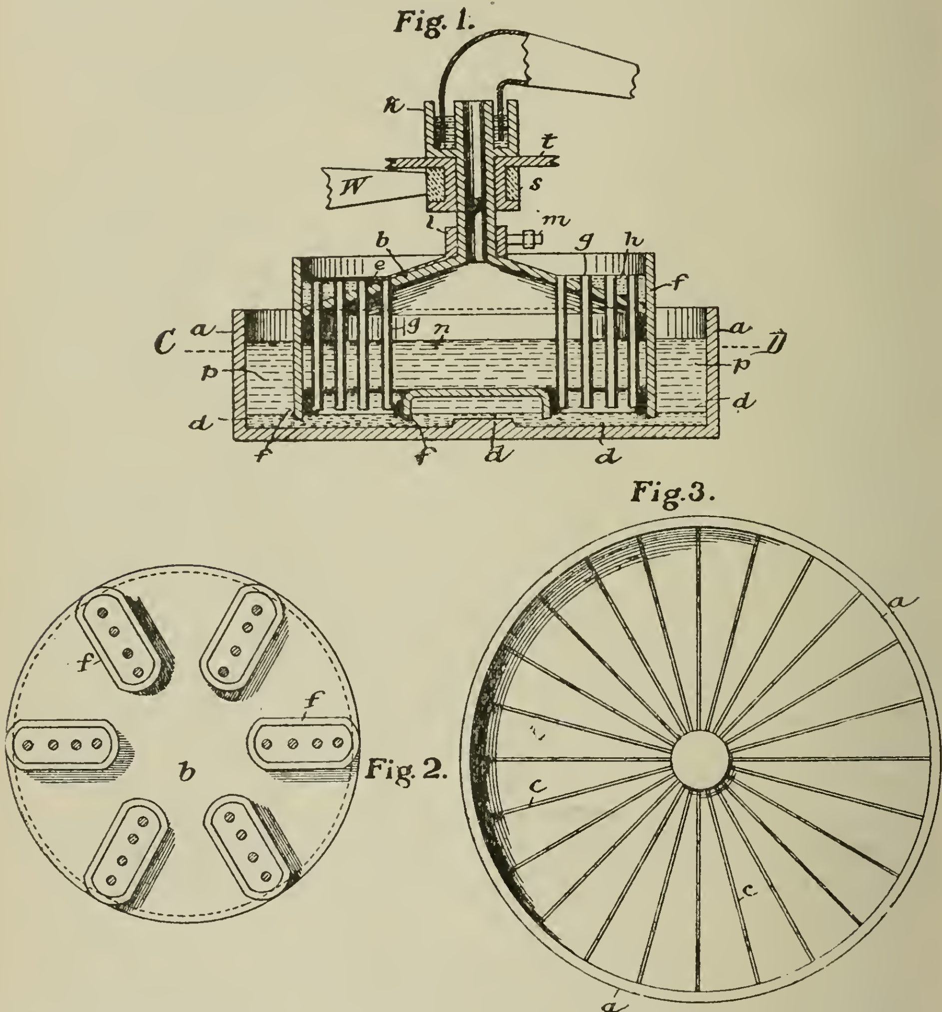
One great difficulty to be contended with in this process is the obtaining of materials which are adaptable and at the same time are not attacked by the chemicals with which they may be in contact. It is essential that no metallic substance be exposed to the action of chlorine.

THE RHODIN ELECTROLYTIC APPARATUS.

The cell employed by the Canadian Electro-Chemical Company is a very simple one, invented by Mr. J. G. A. Rhodin of Manchester, England.[2] It consists of an outer shallow dish or containing vessel (*a*) made of cast iron. Inside this iron vessel there is another vessel (*b*) made of earthenware, from the bottom of which a series of open necks (*f*) project, the edges of which pass down beneath a layer of mercury (*d*) which is placed in the bottom of the iron vessel. In the centre of the top of the earthenware vessel there is a cylindrical opening or tube (*q*) which

[2] U. S. patent 608,300. The cut given with these letters patent is here reproduced to more clearly illustrate the process.

has a water seal (k) at the top. This cylindrical pipe is made to revolve on its central axis so that the whole of the inside vessel is carried around the centre axis of this pipe, which is kept in its place by a bridge spanning the upper portion of the iron containing vessel (a). The revolution of the earthenware vessel, i.e. the electrolytic cell proper, is accomplished by a worm gear not shown in the cut.



Rhodin's Electrolytic Apparatus.

The top surface of the electrolytic cell has six or more upward protruding necks (f), each of which is perforated by a number of holes through which carbon rods (g) are inserted and project, but are not allowed to come into contact with the mercury layer (d). Around the top centre pipe of the electrolytic cell there is a ring of metal (l) which is carried around when the vessel revolves. All the carbon rods are connected with this ring by suitable metallic leads (e). A sliding contact (m) on the metallic ring (l) around the centre top pipe (q) of the electrolyti

cell connects the carbons with the positive pole of a dynamo or other source of electricity. The negative pole of the dynamo is connected with the cast iron containing vessel (*a*). The action of the cell is exceedingly simple. The layer of mercury (*d*) forms a seal with the downward projecting edges of the electrolytic cell (*f*), so that when the electrolytic cell is filled with brine to (*n*) and the outer annular space (*p*) is filled with pure water, no action between the liquid contents of these two compartments can possibly take place.

When the electric current passes through the cell it passes from the lower ends of the carbon rods to the mercury surface through the interposed solution of brine (*n*), and decomposes a portion of it.

The chlorine is given off at the surface of the brine and is drawn away through the top centre pipe and a system of earthenware pipes by means of centrifugal fans to the bleach chambers. There are ten of these chambers having a capacity of five tons each, made entirely of sheet lead with a 2-inch tile floor. Slaked lime is spread out in furrows on the floor of these chambers which are arranged so as to permit any one of them being disconnected from the main chlorine supply pipe if required. When the slaked lime has absorbed 40 per cent. of its weight of chlorine gas it is drawn off at the bottom and packed into barrels for shipment.

The sodium mercury amalgam forms upon the surface of the mercury (*d*) inside the downward protruding necks (*f*) at the bottom surface of the brine and passes, partly by diffusion and partly by the mechanical agitation of the mercury occasioned by the revolution of the electrolytic cell (*b*), to the outer annular space, where a layer of water (*p*) extracts the sodium, forming caustic soda.

The mechanical agitation of the mercury is assisted by placing radiating vanes (*c*) in the bottom of the cast iron containing vessel (*a*) which conduct the mercury amalgam to the outer edge of the vessel.

In order to permit the very highest current density the electrolytic cell should always contain a concentrated solution of salt, which also reduces the electrical resistance of the cell, and permits the use of the lowest potential difference. Concentrated brine is kept in the electrolytic cell by a constant circulation of the liquid, the weaker solution being continually drawn off and the standard strong solution flowing in to take its place. The weaker solution is being constantly pumped up to brine tanks of which there are two in the building of 2,000 cubic feet capacity each. Here, through the addition of salt, the brine regains its concentrated state and is returned again by gravity to the individual cells. The cell is heated internally by means of steam coils, for the purpose of diminishing electrical resistance.

When the caustic soda solution reaches a strength of 23 degrees Beaumé, (200 grammes per litre) the solution is drawn off and conveyed to a sheet iron store tank. The exact amount of such solution produced per hour by the current used is being drawn off continuously, and a corresponding amount of water supplied to the outside annular compartment (p) which compartment consequently always contains a 23-degrees Beaumé solution of sodium hydrate.

The evaporation plant consists of a 1000-cubic feet sheet iron store tank, weak liquor apparatus and finishing kettles.

The electrical installation consists of three 220-K. W. dynamos, each developing 1000 amperes at a potential difference of 220 volts. These dynamos are of the most modern design, and are furnished by the Canadian General Electric Company of Peterborough. Each dynamo is driven by a separate waterwheel. The plant comprises 120 cells, and is divided into three units of 40 cells each, each unit deriving its electrical power from one of the above dynamos, the cells being arranged in series. A current of 1000 amperes at a potential difference of 5 volts, is passed through each cell.

Disintegrator and dressing machinery for a daily output of 14 tons of slaked lime are provided.

The company states as to the capacity of these works that, "the production with an A. H. efficiency of 90 per cent., and a current of 1000 Amp. at 5 volts per cell, will be as follows :—

Per apparatus in 24 hours : 71.60 kg. bleaching powder, and 32.38 kg. caustic soda.

Per works, consisting of 120 apparatus, in 24 hours : 8.592 metric tons or 9 net tons, 941 lbs. bleaching powder, and 3.885 metric tons or 4 net tons, 565 lbs. caustic soda ; per works per year, (300 working days) : 2841 net tons bleaching powder, and 1285 net tons caustic soda.

Raw materials will be required as follows :—Per works per day of 24 hours; 5 net tons, 1364 lbs. slaked lime, and 6 net tons, 526 lbs. salt ; per works per year, (300 working days) ; 1705 net tons slaked lime, and 1879 net tons salt."

As this plant is an example of the most advanced practice in one of the oldest and most important of chemical industries in the world, and as it is the first time that caustic soda or bleaching powder has been manufactured on anything like a commercial scale in Canada, the writer has aimed to put this interesting process on record in some detail, for much of which he is pleased to acknowledge the interest taken by Mr. J. G. A. Rhodin superintendent of the above works at the Sault in supplying particulars.

It is due to the facilities extended the writer when in Sault Ste. Marie by Mr. E. V. Clergue and the managers of the various departments that it was possible to visit the works and collect the necessary technical details for the purpose of this paper.

MINES OF NORTHWEST ONTARIO: PART I.

REPORT BY J. A. BOW, INSPECTOR.

Introduction.

I beg to submit herewith a report of my work of inspection up to Aug. 31, 1900, the date upon which my tenure of the position of Inspector of Mines ceased.

Owing to my abbreviated term of office this year I have not been able to cover the whole district. The localities visited by me up to the expiration of my engagement include: Lake of the Woods and Shoal lake, Sturgeon and Denmark lakes, the Lower Seine, and that part of the district east of Port Arthur along the north shore. There are some working properties in three or four of the above mentioned localities which have not been visited and are therefore not included in this report.

The mining industry in the district has been rather dull during the year; more so than at any other time in the past three or four years. The low water in Rainy river and around Mine Centre has been a great drawback to the Lower Seine country by impeding navigation, and the same thing has given trouble in other parts of the district as well. But as this has been an exceptionally dry season a repetition of this state of affairs need not be expected.

It has been very difficult to attract much capital into the country of late. A reaction has set in which must have been expected from the state of affairs existing for some time previously. It is to be hoped that we are now on the verge of an era in which plain facts, and not opinions, will regain permanently the confidence of capital. The number, and also the proportion, of prospects being worked, and of properties merely under development, is and has been much smaller than usual, but the properties that are being worked are on the whole of a better and more hopeful class than formerly; in short, not so much money is being wasted in the country. We are reaping the benefit of our years of costly experience, and are gradually arriving at a condition in which we will have a fairly good idea of whether a property is worth the expenditure of any money, and of when to stop. The works of the unscrupulous promoter, who is always at large, are of course no criterion of the judgment and common sense of the people in a mining country, but are simply a proof of the gullibility of the public and wealthy innocents or persons who know nothing of mining. There will therefore always be on this account plenty of room for criticism of the severest kind.

The new mining regulations have not manifested themselves very effectively so far; but this is something that should not be forced too suddenly. They have had, however, the effect of throwing more responsibility upon mine managers, and thus keeping them on the *qui vive*. It is impossible to make the same regulations fit every mining country, and these are more the results of what has been found necessary by the experience of this Province than were the old regulations. There is still room, however, for important changes.

Lake of the Woods Region.

SULTANA MINE.

I visited the Sultana mine on July 24 and 25. There was no mining work going on at the time except stoping to keep the mill running, and in consequence the force was small, consisting of a total of 59, including 16 miners.

The total depths of the shafts are as follows: Main shaft, 545 feet; Galena shaft, 164 feet; Crown Reef shaft, 143 feet; No. 3 shaft, on Pasha vein, (full of water) 76 feet.

Main Shaft: First level: north: The entrance to the north drift is timbered over securely to prevent access.

South : The south drift has been driven a distance of 460 feet beyond the Galena shaft. Stoping is in progress in the drift which extends north-east from the Galena shaft on the Galena vein. The length of the stope is about 30 feet ; the height, about 40 feet, and the width 5 feet. The dip of the vein is nearly 45 degrees south. The shaft is securely timbered over at the level.

Second level : north : The stope above the level in the north drift has been securely covered underneath by timber and lagging.

South : The south drift has been driven through to the Crown Reef shaft, the total distance along the drift between the Main and the Crown Reef shafts being 759 feet. The latter shaft connects with this level at a depth of 128 feet. It is sunk 15 feet below the level, and is securely timbered over. The following drifting has been done on the level at this shaft : West, 110 feet ; south-west, 20 feet ; east, 26 feet. An ore chute has been constructed at the level for handling the ore which is underhand-stoped above the level in the shaft. The underhand stope is about 40 feet long, and between 50 and 60 feet deep below the floor of the open cut on the Crown Reef vein. A pillar 16 feet long and 8 feet deep is left to support the stope, which is not timbered. A suspended ladderway extends down the foot wall from the floor of the open cut to the bottom of the stope. There is also overhand stoping in progress on the Crown Reef vein at the second level. The stope is 20 feet long, and from 8 to 10 feet high above the drift. Two crosscuts about 33 feet in length each have been driven east from the main drift between the two shafts.

Third level : The third level has been abandoned. A portion of the floor, about 35 by 40 feet in size, of the large stope south of the shaft, has been removed by underhand stoping, and the entrance to this part of the level boarded up at the shaft. A doorway has been left, but the door is kept nailed up to prevent access.

Fourth level : The north drift in the fourth level has been driven a total distance of 199 feet and discontinued, as no ore has been struck.

The ore in the breast of the south drift is being removed by underhand stoping. A No. 4 Cameron pump is installed in this level.

Fifth level : The fifth level is abandoned for the present. The south drift is timbered over to prevent access to the large stope, the floor of which has been removed to allow filling of stope underneath with waste rock.

Sixth level : The north drift is timbered over to prevent access. Underhand stoping with the following dimensions has been done in this drift ; length, 40 feet ; depth, 45 feet ; width, 10 feet.

South of the shaft a timbered passage has been constructed through the large stope to the south end, and the drift extended 12 feet beyond the stope. The total length of the drift from the shaft is 49 feet, length of timbered passage 37 feet. The sets are substantially constructed, 5 feet wide by 7 high, and are placed 4 feet apart. The top and sides are closely lagged and the outside space filled with broken rock. At a distance of 12 feet from the shaft a vertical passage has been cribbed up extending to, or connecting with, the level above for ventilation. By constructing passages through the abandoned portions of the stopes a large available space can be made use of for disposing of waste rock, thus avoiding the necessity of hoisting it to the surface, and at the same time the danger from having large open chambers underground is obviated.

Seventh level : north : The north drift has been driven 160 feet. At a distance of 35 feet from the shaft a branch drift has been driven 43 feet east. The size of the drifts is 7 by 7 feet.

South : The cistern has been timbered over, and a tramway laid for drifting beyond. From the south end of the pump chamber a drift has been driven east 35 feet, and an inclined upraise in same driven 35 feet. A No. 5 Cameron pump is installed at this level.

Eighth level : This is established at a depth of 535 feet. There were several feet of water in the level at the time of my inspection, so I could not get down to it. Drifting has been carried north 12 feet and south 11 feet.

The ladderway and the skip road have been completed as far as the seventh level, and constructed according to the Mines Act. From the seventh to the eighth level a substantial suspended ladderway is provided, but is not yet cased off from the hoisting compartment or provided with platforms.

No. 3 shaft: A shaft, known as No. 3, has been sunk on the Pasha vein, but it was full of water at the time of my visit. It is reported to me by the captain to be 76 feet deep, with a vertical dip and a cross section of 8 by 16 feet. At the bottom there is a drift north 18 feet. The shaft is suitably covered. A neatly framed shaft house about 25 feet high has been constructed of 10 by 10 inch timbers. A pocket for dumping the bucket has been provided in same, with two chutes. A small oscillating cylinder duplex air hoist is installed. Hoisting was originally done by the second drum of the main hoist, from which a series of standards has been erected for supporting the cable.

The following instructions were left in the Inspector's book: 1. As no timbering is provided in the Crown Reef underhand stope, keep walls carefully scaled. 2. Dispose of old powder thaw cans in future by burning or exploding.

A fatal accident occurred on July 21, in which one man was killed and another injured in an explosion caused by cutting an old powder thaw can. A report of the accident was sent in by me to the Department.

WENDIGO MINE.

The Wendigo mine is situated on La Belle lake, north of Witch Bay, Lake of the Woods. It is reached by steamboat from Rat Portage, a distance of about 20 miles, and a half mile road leads from the landing to the mine. The property consists of three locations, M H 208, 209 and 210. The two former aggregate 83 acres. The last has an area of nine acres, and consists of Gagne lake, or land under water. The property is owned and operated by a syndicate consisting of Charles Gooderham and Wm. McKenzie, of Toronto; Sir Richard Cartwright, K.C.B.; Clarkson Jones, and others. The head office is 37 Yonge St., Toronto. Mr. M. T. Hunter is manager of the mine, and Israel Gagne, the original owner of the property, mine captain. The total force is 33; number of miners, 12.

The formation is green schist, with a strike of east and west. There are several veins which consist of zones of schist impregnated with sulphurets and quartz in small stringers or lenses, and in some places in large bodies. The main vein has a strike of about east and west. It is traceable along the surface for several hundred feet, outcropping on elevated ground. It is possible that it extends much further than the surface exposure indicates. The exposures consist of oxidized cappings showing a little quartz. The other veins occur close by on both sides, and can easily be exploited underground by crosscuts from the shafts on the main vein.

Two shafts have been sunk 240 feet apart on the main vein, with a dip of nearly 90 degrees north. The main shaft was not accessible below the first level at time of inspection, as a shaft house was being erected, and mining work could not be carried on there. The depth of the shaft is 108 feet, and the size 7 by 11 feet. A neat collar extends to a depth of 7 feet. The manway is 4 feet 4 inches by 7 feet in size, and provided with platforms, but not yet cased off from the hoisting compartment. The first level is at a depth of 50 feet, where there is drifting east and west along the vein 25 feet each way. No. 2 shaft is 75 feet deep and 7 by 9 feet in size. A ladderway is suitably constructed with platforms and division as far as the first level, which is at a depth of 60 feet. There is a drift east at this level 13 feet, one west 8 feet, and a crosscut north 8 feet. A platform with trap door has been constructed at the level, but no guard rail provided.

The vein in the main shaft shows a width of 7 or 7½ feet, or all across the shaft, and the walls do not appear to be reached. It consists of schist mixed with quartz, as stated above. In

one place above the first level the vein is nearly all quartz for about 7 feet. The rich ore, or pay streak, is 3 or 4 feet wide. The whole body is heavily mineralized, principally with copper pyrites and sulphides. The sulphurets are disseminated all through the vein ; but at the same time they occur in masses or stringers of various sizes. In No. 2 shaft the vein does not look so well as in No. 1; but there is a large band of almost solid pyrites in it, carrying a considerable percentage of copper. Two hundred tons of the ore from development work was shipped to the Rat Portage Reduction Works in barges and milled very satisfactorily. There was an exceptionally large percentage of concentrates in the ore. These have been shipped to New York for treatment and I have not yet learned the results; but the percentage of copper is estimated to be sufficiently high to pay for the mining and milling, etc., of the ore, leaving the gold contents clear profit.

The hoist for both shafts is situated at No. 1. It is a 20-h.p. duplex double drum, with ¾-inch steel wire hoisting cable. The boiler is a 20-h.p. return tubular. A large shaft and crusher house, about 60 feet in height, is being erected at the main shaft, the timbers of which are 12 inches square. The framework was almost completed at the time of inspection. A bucket is employed for draining underground. Sink-holes are blasted by battery, and stope and drift holes by fuse. The buildings on the property consist of sleeping camps and office, cooking and dining camps, shaft and engine houses, blacksmith shop, carpenter shop, powder magazine, and five private dwellings at the lake. A dock has been constructed at the steamboat landing at Witch Bay.

The following instructions were left in the Inspector's book : Provide guard rail at the mouth of, and at first level in No. 2 shaft, and also at No. 1 when reopened.

Date of inspection, July 28.

TRIGGS MINE.

The Triggs mine closed down on July 14, owing to lack of capital for further development work. One hundred tons of the low grade ore have been brought in for treatment at the Keewatin Reduction Works, and if $2.50 per ton, or more, is obtained, the result will be considered satisfactory. Mr. Triggs has hopes, in the event of such being the case, of being able to obtain sufficient capital for the further necessary development of the mine by the sale of treasury stock. The capital of the company is $500,000, divided into 100,000 shares with a par value of $5 each. Twenty thousand shares are in the treasury, and these cannot be sold at less than par value.

Mr. Triggs gave me the following underground measurements since the closing down of the mine :

Main shaft ; depth, 225 feet. First level : depth, 108 feet. No. 1 crosscut, driven northwest from shaft, 58 feet. Drifting in crosscut at distance of 51 feet from shaft ; length, 206 feet ; direction, west. Drifting from about same point in crosscut 42 feet east. No. 2 crosscut; at a distance of 90 feet west from No. 1 crosscut, in west drift ; length, 18 feet ; direction, southeast. No. 3 crosscut, in same drift, at a distance of 186 feet from No. 1 crosscut ; length, 58 feet ; direction, southeast ; driven towards air shaft, which is 242 feet from the main shaft, and 61 feet deep, vertical dip. A crosscut has also been driven 19½ feet northwest from the same drift at a distance of 51 feet from No. 1 crosscut.

Second level : depth, 208 feet : crosscut, northwest from shaft, 29½ feet. Drifting from end of crosscut, 59 feet west and 50 feet east.

Total length or amount of development work on property, 826 feet. Other shafts have been mentioned in previous reports of the Bureau.

REGINA MINE.

The Regina mine is in the hands of the bond holders, and the trustee for these is Lieut-Gen. Sir Henry C. Wilkinson, K.C.B.. chairman of the company that owned and operated the property. A new company has been organized, and if sufficient stock can be sold the property will be taken over. The mine was examined last fall by an expert whose report is said to have been satisfactory.

LA MASCOTTE MINE.

On 11 July I went down with Mr. Alan Sullivan of the Anglo-Canadian Gold Estates, Limited, to La Mascotte mine, one of the shafts of which was bailed out to be examined by Mr. Sullivan for his company. This property has not been in operation for two or three years, but accounts of same will be found in previous reports of the Bureau. The shaft which was bailed out is at the foot of the hill. It is 38 feet deep, and at a depth of 30 feet there is a drift 17 feet north. The vein in this shaft is the most promising looking on the property ; but like all the others, it is very irregular, consisting apparently of a shoot crossing the shaft with a pitch to the north, and ranging in width from a few inches to three feet. Some very high assays are said to be obtained from it, but these were very variable. Two diamond drill holes were made about two years or more ago which were put down from the same point about 70 feet west of vein. They were bored towards the shaft so as to cut the vein perpendicularly to its strike, as follows : No. 1 bore ; dip, 45 degrees; depth, 240 feet. No. 2 bore ; dip, 60 degrees; depth, 260 feet. The dip of the vein is about 55 degrees northeast, as far as can be ascertained by the shaft.

TROJAN MINE.

I visited the Trojan mine on July 12, and found it closed down and the machinery all removed to the steamboat landing awaiting transportation from the property. No. 3 shaft, on the hill top, was nearly full of water. I was informed that it was about 140 feet in depth. The syndicate who were operating the property apparently did not get any satisfactory results, and have given it up.

BULLY BOY MINE.

The Bully Boy mine has been closed down since June last. Owing to non-payment of wages a seizure of the property has been made. Mr. J. M. Jones, who superintended mining operations, informed me that the shaft had been sunk to a total depth of 170 feet, and the vein looked very well at the bottom.

COMBINED MINE.

The Combined mine has been idle all summer. Mr. J. F. Mieville spent a few days on the property in the latter part of July, and made a report on same. The company are endeavoring to have operations resumed.

BOULDER MINE.

The Boulder mine has not been in operation since last fall. Mr. Gifford, who was manager previous to the shut down, informed me that the main shaft had been sunk to a total depth of 300 feet. Four levels have been established, with drifting or crosscutting in each. A diamond drill bore was driven west from the bottom of the shaft, but nothing satisfactory was revealed. On the whole, the results of development work were not promising.

RELIANCE MINE.

The Reliance mine is the property described in last year's report as belonging to the Anglo-Canadian Gold Estates, Limited, and is situated on the southwestern extension of Denmark lake, east of Whitefish bay, Lake of the Woods. The property consists of two 80-acre locations, viz., F M 171 and 172.

No. 3 shaft has been sunk to a total depth of 33 feet, and discontinued.

No. 1 shaft is 110 feet deep. At a depth of 60 feet a drift has been driven north 21 feet, and one south 50 feet. At a distance of 10 feet from the shaft in the south drift a crosscut has been driven southeast 10 feet. Size of drifts and crosscut, 4½ by 6½ feet. At a depth of 108 feet a sub-level has been established with a crosscut northwest 28 feet. A station for the diamond drill is being made in this crosscut. The vein, which showed up fairly well, and contained excellent values in the upper part of the shaft, has depreciated. It was thought that it had been lost in the course of development, so the diamond drill was employed to investigate the matter. I learned later from the manager that the drill revealed nothing satisfactory. Mining work has been suspended in this shaft also.

One No. 3 Rand drill, operated by steam, was employed. An 8 by 8 inch wooden piping extends down the shaft, and to a height of 33 feet above the surface, to carry off the exhaust, and incidentally to give ventilation. A neatly constructed head frame, 30 feet in height, suitably braced, and built of 10 by 10 inch timber, has been erected. A three-pole skidway extends to the bottom of the shaft. The hoisting machinery consists of a 6½ by 8½-inch duplex hoist with 24 inch drum, 400 feet of ⅝-inch steel wire cable, two wooden buckets, a 4½-foot sheave and a 25-h. p. locomotive boiler. The engine house is a neat frame building, 22 by 24 feet in size. There is 50 feet of tramway and one car on surface. A test pit has been sunk to a depth of 17 feet, and is being continued on an adjoining property which has not yet been surveyed.

Owing to the suspension of work in the main shaft the force has been reduced to 7, including 3 miners. Alan Sullivan is manager, and H. Patterson, assistant.

The ladderway in the main shaft extends to the bottom, but is not cased off from the hoisting compartment or provided with platforms. Instructions were left in the Inspector's book to construct the ladderway according to the Mines Act, to provide a guard rail at the shaft mouth, and to fence No. 3 shaft. Date of inspection, July 12.

In the latter part of June Mr. Sullivan took a gang of prospectors down to the Dick and Banning timber berth south of Calm lake on the Lower Seine. Later on he made a splendid discovery farther up the Seine, and will prosecute work at once on same.

GOLD PANNER MINE.

I visited the Gold Panner on July 13. Following were the underground measurements on that date : depth of shaft, 100 feet ; dip, nearly 90 degrees west as far as first level, and about three degrees east below this. First level : depth, 70 feet ; north drift, 62 feet ; south drift, 49 feet. The drifts are 7 feet high and are now being made 4 feet wide, but the south drift is 9 feet wide for the first 18 feet.

The vein, as described in last year's report of the Bureau, consists of a much altered zone in a wide belt of felsitic or hydromicaceous schist impregnated with quartz and pyrites and other sulphurets. The width of the ore body is indefinite ; there was about 8 feet on surface. This narrowed, or depreciated somewhat, down by the first level, but I was told that it had improved again in the shaft below. I could not get below the level as a pentice was being constructed there. The belt of schist is probably over 100 feet in width, and there are apparently other zones of altered and silicious matter not far from the main vein, so that it is as yet impossible to form any idea of how much of the schist is pay ore. It appears to be a proposition that will be perman-

ent; and the results of the first mill run, eight dollars per ton, are certainly very encouraging. It is not expected that the present stamp mill will much more than pay expenses.

The shaft north of the main shaft is said to have been sunk 19 feet but it was half full of water at the time of my visit.

The ladderway in the main shaft is roomy, and constructed suitably, with division and platforms, as far as the first level. There is a proper platform at the first level, and a pentice is being constructed, with heavy trap door, in the shaft at a distance below the level equal to the depth of the bucket, so that sinking in the shaft and drifting in the level can be carried on simultaneously with safety. A pole skidway extends down the shaft.

The shaft and crusher house is 55 feet in height, this unusual height being necessitated by the fact that the shaft is on a steeply sloping hillside. The building is substantially constructed, and has separate stations for dumping waste rock and for discharging ore. The hoisting machinery consists of a small Cooper duplex hoist with 24 inch drum, ⅝-inch steel wire cable, 24-inch sheave and 1,200-lb. steel bucket. The crusher is a Blake, with 5 by 9 inch opening, and is driven by a 10-h. p. horizontal engine. The foundation of the crusher is firmly braced to prevent vibration. A 20-h. p. locomotive boiler supplies steam for the hoist and the crusher engine.

A tramway 60 feet in length, on a trestle 10 to 20 feet high extends from the crusher to the mill. The mill building is 20 by 40 feet in size, and is built of neatly hewn timber and sawn lumber. The foundation is solid rock. It is situated on the hillside at such an elevation that the tailings discharge is 25 feet above the lake. This elevation was given to allow for treatment of the tailings by cyanide, the plant for which is to be erected immediately. The mill machinery consists of: ten stamps, in two batteries of five stamps each, two Tullock feeders, apron plates, riffle trough. mill pump at lake, 60-h.p. return tubular boiler, and a Goldie and McCulloch single cylinder, 10 by 14-inch engine. The batteries are from the old Regina mill, but they are in good condition. They are well set up, and were working nicely at the time of my inspection. The following are the details of mill practice: weight of stamps, 950 lbs.; number of drops per minute, 93; height of drop, 8½ inches; depth of discharge, 7 inches; screens, 30 mesh, diagonal slot; back and front inside plates; lip plates; apron plates, 4 by 12 feet, inclined 2 inches per foot.

The following plant for the cyanide works is on the property: eight tanks (not yet put together); two 16 feet diam. by 4 feet high; two 20 feet diam by 3½ feet high; three 10 feet diam. by 3½ feet high, and one 6 feet diam. by 2 feet high, inside measurements; three extractor boxes, pulsometer pump and all other necessary apparatus, including a supply of cyanide and zinc. The tailings will all be treated and no concentrates will be made.

The buildings on the property consist of boarding and sleeping camps, manager's office, assay office, shaft and crusher house, mill building, powder magazine, stables and three private dwellings.

Mr. Wm. Smaill is superintendent of the mine and the mill. The total force is 44; number of miners, 22.

Instructions were left in the Inspector's book to provide guard rails around the hoisting compartment at the waste dumping and ore dumping stations.

VIRGINIA MINE.

The Virginia mine has been closed down since the latter part of April. Mr. Rayburn, the manager, informed me that it would be reopened in several months, when certain business matters could be adjusted.

NINA MINE.

The Nina mine is the Scovil-Moore property on Deer lake, about four miles north of the Virginia mine. I did not visit it while in that vicinity, as it was closed down at the time. Mr.

S. H. Reynolds, the manager, informed me that work ceased on July 9, owing to difficulties in making terms with the owners, Messrs. Scovil, Moore and Pritchard, of Rat Portage. The Great Granite Gold Mining and Development Company of Ontario, Limited, had an option on the property, with the privilege of buying it for $21 000 payable in instalments of $3000 each, and in addition allowing the sellers a certain amount of stock in the company. A new company, subsidiary to the old one, named The Nina Gold Mining Company of Ontario, Limited, has been formed and has taken over the option. The first $3000 was paid before work was commenced, and the second $3000 has been paid since operations have been suspended, so that work will be resumed, but probably not before the "freeze-up," as hoisting machinery will have to be taken in over the ice. The manager gave me the following notes on underground work: Depth of shaft, 123 feet. At a depth of 73 feet drifting has been done along the vein east 32 feet, and west 24 feet. A tunnel has been driven on another vein 70 feet.

MIKADO MINE.

The Mikado mine has been doing splendid work for the past year. Both mining and milling have been going on steadily. A change in the method of developing has taken place since the peculiar nature of the ore shoot (as described in previous reports) had been discovered and its pitch established. Instead of sinking in the main shaft and drifting to the shoot, which involved an enormous amount of dead work, an inclined winze is being sunk from a point in the fourth or lowest level, which is driven from the shaft, following the underside of the shoot, and levels are driven off from the incline through the shoot at suitable intervals. The incline will be completed to the surface as soon as possible, but this will be described further on. Following are the measurements of recent underground work:

First level: At the first level underhand stoping has been resumed where the crosscut from the shaft meets the vein. There is a body of good ore remaining which is well worth extracting; and at the same time the work of excavating the passage for the new incline is being furthered.

Second level: In the second level a block of ore 60 feet long by 30 feet high, just north of the winze which connects with the first level, has been removed, and overhand stoping is still in progress. There is a body of ore 80 or 90 feet long and 10 or 12 feet deep, just underneath the level, which is being removed by underhand stoping to make way for the incline.

Third level: The total length of the third level is 356 feet. Overhand stoping: length, 230 feet; average height, about 40 feet.

Fourth level: North drift, unchanged. South drift, 652 feet. Overhand stoping; length, 180 feet; stoped out to level above, leaving pillar 5 by 40 feet at floor of third level, and a mass of ore 70 feet long for protection of hoisting chamber at incline. There are also several small overhand stopes in this level.

Fifth level: The fifth level is driven south from the inclined winze which, as stated in last year's report, is sunk with a dip of 35 degrees south from a point 381 feet from the main shaft, in the fourth, or 240 foot, level. Depth of fifth level (vertically from mouth of shaft) 290 feet; length, 232 feet. There is a winze connecting the fifth with fourth level at a distance of 100 feet measured along the fifth from the incline. Overhand stoping; average length, about 64 feet; stoped up to fourth level. Depth of incline below fifth level; 58 feet, measured along incline.

A skipway with skip and small air hoist have been installed at the incline. The hoist is situated on an elevated staging above floor of fourth level. A chute has been constructed through which the skip dumps into the cars.

New inclined shaft: The inclined winze at the 240-foot level was originally intended to be a portion of the new incline which will extend from the surface, but the dip proved to be greater than that of the ore shoot, in consequence of which, each additional level would involve an in-

reased amount of dead work before the ore was reached. Therefore the incline will be given a lip of 26½ degrees instead of 35, and it will pass through a short distance south of the present nclined winze. The mouth of the incline will be at the north end of the open cut west of the nill. The lowest point in the present workings, through which the incline will pass, is on the ifth level, at a distance of 640 feet from the mouth of the incline. Two points were chosen, one at the surface, and the other at the fifth level, through which the incline is to pass, and it is o be kept perfectly straight. A survey has demonstrated that a comparatively small amount of rock will have to be removed to complete the incline as far as the fifth level, or a distance of 640 eet, as stated. From 10 to 14 feet is estimated to be the greatest width of cut into the wall on either side. With the exception of a little good stoping ore in several places the ground through which the incline passes is all stoped out as far as the fifth level, and if it were not for the unevenness of the dip and the strike of the vein no excavation of rock would be required with the exception of the small amount of ore referred to. Consequently the carrying out of this scheme will not be very costly. Where the incline has not a shelf of rock underneath, substantial stulls at 8 foot centres will be provided to carry the skipway. Overhead stulls and lagging will also be required for protection, as there is considerable stoped out space above the incline for almost the entire depth. The height of the passage will be 10 feet. Sufficient width will be allowed for a manway. A large portion of the filling of the open cut has been removed, and the setting of the stulls for the skipway has been commenced.

A large shaft house will be built which will also contain the crusher and sorting plant. A new 100-h.p. hoist with drums 6 feet in diameter has been ordered, besides two new return tubular boilers of 125-h.p. each. The old hoist will be utilized for exploratory work in the present main shaft and for development etc. in No. 2 shaft.

From the end of the crosscut from the main shaft, at the 240-foot level, an exploratory winze will be sunk, following the vein, with a view to the further testing of this part thereof. The north drift at this level will also be continued several hundred feet farther, as there is a contact to the north at which an ore shoot may have been developed similar to the main one. It is likewise the intention of the company to cut the vein below the 240-foot level with the diamond drill, which will be stationed in the crosscut between the main shaft and incline at that level.

The main shaft house has been roofed and boarded in, and a waste dump tramway on trestle constructed on the south side.

No change has been made in the mill. The sorting plant has been completed, but it will be removed to the new shaft house as soon as the latter is completed. This will bring the plant to the opposite side of the mill, as its present position involves unnecessary handling of the ore. The cyanide plant is in the same condition as formerly. Its capacity is to be increased immediately by the addition of two more vats. A new dynamo with a capacity of 100 lights of 16-c.p. has been installed and 50 lights are in use.

The wood conveyer has been removed to a position near the mill, to avoid needless handling of wood. Five thousand cords have been contracted for, and the greater part of the contract has been filled. The wood costs $2.80 a cord piled on the property.

At the time of my inspection, July 19, the foundation was being prepared for a new boarding house to cost $3,000.

The staff and employes at the mine at present are as follows : Manager, N. McMillan ; underground foremen, Joseph Hicks and Jas. McKenzie ; mill and cyanide superintendent, David John ; accountant, A. Milne ; number of miners, 24 ; total force, 84, not including wood contractors. F. C. Pengilly, the late superintendent, severed his connection with the company on May 31. T. R. Deacon of Rat Portage, the local director, has general supervision over affairs at the mine.

The following extract from the Inspector's book refers to the condition of the mine, and gives instructions left. "1. Stopes are in most cases timbered over underneath by stulls and lagging. Broken ore and rock is piled on the lagging. The stulls are sufficiently substantial, but in a number of places the lagging is loosely laid, and pieces of rock are liable to drop through, making it dangerous in the passages below. Remove all such loose or dangerous pieces and place lagging more securely. Ore chutes through the lagging are in some instances insecurely covered, and loose pieces of rock surrounding same are liable to drop through. Keep all loose rock away from edges of mill-holes or chutes, and keep these securely covered. Examine stopes daily, and scale if necessary. Provide guard rails at all winzes where men are liable to pass. Post a notice marked 'Poison' in cyanide works at outlet of pipe from extractor boxes, and also at cyanide box, or else keep the latter securely covered."

SIRDAR MINE.

The Sirdar Mine includes the following property on Bag bay: D 410, 411, 412, 418, 419, 419 A, and 421, S 182 and 184 and S V 209. aggregating 1,209 acres. It is owned by The Sirdar Gold Mining Company, Limited; capital, $1,000,000; head office, McKinnon Building, Toronto; president, John Flett, Toronto; vice-president, A. Allan, Toronto; managing director, John T. Moore, Toronto. Mr. Theodore Breidenbach has ceased to be manager, and Oscar Smith was in charge of the work at the time of my inspection, July 18. Mr. G. Warren is business manager *pro tem.* The total force was 16; number of miners, 8, including both locations, 410 D and "Sirdar Point," or S 182.

No work was going on below the first level in the main shaft on 410 D at the time of my inspection, and the second level was inaccessible, owing to water. The south drift at the first level has been driven a total distance of 49 feet, and is continued. The measurements in the second level were given me by Mr. Smith as follows: South drift, 130 feet; crosscut in drift, 100 feet from shaft, driven east 318 feet; crosscut close to shaft, driven west 169 feet. Drifting in west crosscut; first drift, 32 feet from main drift, driven south 28 feet; second drift, 147 feet from main drift, driven south 69 feet. North drift, 67 feet. In the west crosscut a diamond drill bore has been driven west horizontally 200 feet from the end of the crosscut.

A new duplex hoist with 8 by 10-inch cylinders and 30-inch drum has been installed. It is reversible, with friction clutch and band brake. The cable is steel wire, $\frac{5}{8}$-inch in diameter. The second half of the duplex compressor has been put in, and is working nicely.

The shafts on Sirdar Point (S 182), measure as follows: Belt vein shaft No. 1; vertical depth, 107 feet; crosscut 20 feet east at depth of 100 feet, and drift 4 feet at same level. Shaft full of water; suitably fenced. Belt vein shaft No. 2; depth, 69 feet; size, 5 by 9 feet; dip, about 70 degrees west. Not fenced or covered and full of water. No. 3 shaft on supposed Mikado vein; depth, 20 feet; size, 4 by 8 feet; continued.

The following notes on diamond drilling done on the same location were given me by Mr. Smith: Total number of holes, nine; total aggregate length, 2,575 feet. Bore No. 1, on Belt vein, dip, 50 degrees, length, 282 feet; No. 2, on Mikado vein, dip, 45 degrees; length, 300 feet; No. 3, on Mikado vein, dip, 36 degrees; length, 220 feet; No. 4, at No. 1 shaft, Belt vein, dip, 30 degrees; length, 215 feet; No. 5, at same shaft, dip, 60 degrees; length, 203 feet; No. 6, under No. 2 shaft, dip, 45 degrees; length, 315 feet; No. 7, under proposed mill site, dip, 45 degrees; length, 345 feet; No. 8, opposite manager's dwelling house, dip, 45 degrees; length, 301 feet; No. 9, dip, 45 degrees; length, 296 feet. Total average cost per foot, $1.26. Average rate of drilling, 16 to 18 feet per day of 20 hours.

The following note regarding the condition of the mine, etc., was left in the Inspector's book:—(1) Hoist brake at main shaft on 410 D will not hold empty bucket; should be replaced by a wheel brake. (2) No. 2 shaft on S 182 is not fenced. (3) Timber No. 3 shaft on S 182 if ontinued below 25 feet.

BULLION NO. 2 MINE.

I visited the Bullion No. 2 Mine on July 20 and found it closed down. Mr. R. Rogers, of Rat Portage, secretary of the company which owns the mine, gave me the following information concerning the same : The property was sold on Aug. 15, 1899, to parties who have since formed The Bullion No. 2 Mining Company, Limited ; capital, $1,000,000 in $1 shares ; head office, Rat Portage ; president, Sir Richard Cartwright, K. C. B. ; first vice-president, D. C. Cameron, Rat Portage ; second vice-president, John Morty, London, Eng. ; treasurer, Walter McDonald, Toronto ; secretary, R. Rogers. The mine has been closed down since June 1, and will be re-opened about Oct. 1, next. No. 1 shaft has been sunk to a total depth of 115 feet, and about 300 feet of drifting and crosscutting has been done therein. No. 2 shaft is in the same condition. A new shaft, No. 3, has been sunk about 30 feet.

CROWN POINT MINE.

The Crown Point Mine has been working most of the summer. While I was in the vicinity the main shaft house was burned down on the night of July 19. Mr. Sharp, the mine captain, informed me that the timbering in the shaft was burned for a certain depth, preventing access, and work was therefore suspended. The underground measurements, as obtained from the foreman, are as follows : Main shaft, depth, 125 feet ; first level ; depth, 60 feet ; drifting east, 100 feet ; contact shaft, depth, 60 feet ; air shaft, depth, 65 feet. Work had been discontinued in the last two shafts some time previously.

IMPERIAL MINE

Mr. A. A. Hare, manager of the Imperial mine, informed me that the mine had been closed down since about the middle of July. Since last year's report the shaft has reached a depth of 110 feet, with drifting at the first level 12 feet east and 25 feet west, and at the second, or 100-foot level, five feet east. Considerable surface prospecting has also been done on the property, but results have not so far proved satisfactory.

CAMERON ISLAND MINE.

I received a letter from Mr. George Thurber, in charge of the Cameron Island mine, dated Aug. 11, in which he informed me that the mine had been closed down since March 25 last. The following notes on underground measurements were contained in the letter : Depth of shaft, 132 feet. At the first level the southwest drift had been driven 217 feet along the vein, and some crosscutting done, making in all 375 feet of drifting and crosscutting underground.

The Lower Seine Region.

GOLDEN STAR MINE.

I visited the Golden Star on June 26 and found mining operations not very active. The main shaft was full of water below the fifth level, and the force employed underground was very small. There was some difficulty about getting a blacksmith at the time, and of course it is impossible to carry on mining to any extent without a competent man to sharpen drills. But it was expected that the force would be largely increased at once. Advantage was taken of the partial suspension of work underground to close the mill for a few days and make some small repairs. The manager, Mr. Flaherty, informed me that it was the intention of the company to install an additional ten stamps almost immediately, but the arrangements to that end had not been definitely concluded at the time. The manager also informed me that the ore shoot had been passed through in the sixth level north, and had just been reached in the seventh, and that

the vein was of good width and well defined, but too low grade to be treated profitably by ten stamps.

An area of 20 acres at the mill site on the water front on J O 41, and also a strip 100 feet in width along the tramway, have been leased for a period of 20 years by the Golden Star company.

The underground measurements showing recent work in the main shaft and other test shafts are as follows: Depth of main shaft, 532 feet.

First level: north: length of stope, 70 feet; average height, 35 feet.

No work has been done in the second or third levels since last report.

Fourth level: north: length of drift, 263½ feet. Overhand stoping; all ore for a distance of about 100 feet stoped out to third level, leaving shaft pillar 7 to 27 feet long; north of this the stope has been carried 85 feet with an average raise of 25 feet.

Fifth level: north: length of drift, 126 feet. Overhand stoping has been carried along for nearly full length of drift to a height of 15 to 50 feet, leaving shaft pillar eight feet long.

Sixth level: Under water at time of inspection; measurements obtained from plan. South drift; length, 40 feet. North drift; length, 180 feet. Stoping in north drift: (*a*) length, 25 feet; height, 25 feet; (*b*) length, 40 feet; height, 25 feet; (*c*) length, 44 feet; height, 20 feet.

Seventh level: Depth, 530 feet. South drift, 10 feet. North drift, 48½ feet.

On the west side of the property there is a vein which is apparently traceable across location A L 114, and partly on J O 41, by two outcroppings. At the north end, where it crosses on J O 41 a test pit has been sunk 10 feet on J O 41, and is being continued. At the south end, or the other outcropping, a shaft is being sunk which has reached a depth of 68 feet. The size of the shaft is 4½ by 8 feet, and the dip about 70 degrees southwest. At a depth of 50 feet a drift has been driven south along the vein a distance of 14 feet, and the ore stoped out overhead to a height of about 20 feet. The vein is rather small in the vicinity of this shaft, averaging less than a foot in width, but the quartz is good looking, carries galena, zinc blende and other sulphurets, and is said to be quite rich. Hoisting is done by a small hoist worked by compressed air from the compressor at the mill. There is a two-pole head gear, and an ore chute on surface to convey the ore to a suitable distance from the shaft without tramming. There is no ladderway or skidway in the shaft; the bucket slides on the bare rock. One machine drill is employed.

The shaft on J O 41 near the tramway has been sunk to a total depth of 40 feet, but was full of water at the time of inspection.

Mr. R. H. Flaherty still fills the position of manager. E. J. O'Brien, the late mine captain, has left the employ of the company, and his position has not been filled. Geo. R. Verry is mill superintendent.

The following instructions were left in the Inspector's book: (1) Close up opening in casing below first level. (2) Keep guard rail in place around skipway at first level. (3) Fence off drifts where underhand stopes occur when not in use. (4) Keep stope in first level carefully scaled. (5) Provide ladderway and skidway at new shaft on A L 114.

Four casualties, including one fatality, occurred at the mine during the past winter and spring. Reports of all have been sent to the Director of the Bureau of Mines.

OLIVE MINE.

I visited and inspected the Olive mine on June 27. Mining operations had ceased a few days previous to my arrival, and the mill, which was running on ore in the bins on surface, was to have closed down at the end of the month. The reasons for closing down are rather complex, but a change of management precipitated the move. Mr. N. B. Hall, having fulfilled his contract of one year's service as manager, has resigned his position. Mr. W. A. Preston, the former manager, and managing director of the company, will take charge if operations are resumed

Mikado Gold Mine: General View of Works.

 Mikado Gold Mine. Shaft and Crusher House: Stamp Mill: Hoisting Plant.

Jack Lake Gold Mine.

Stamp Mill at Glass Reef Gold Mine.

until a successor to Mr Hall is appointed. It is expected that the mine will be re-opened before long. It appears that the company has not been able to keep development work sufficiently far advanced for the 25 stamp mill, and it will have to invest a considerable sum in development work before profit can be obtained from the mill. It would require a much larger mill to profitably treat what is known as the "dike" matter, of which there is an unlimited quantity ; and as the vein proper, or pay streak, which consists of rich quartz, is very small, extensive development work will be required to keep 25 stamps supplied with this class of ore.

The underground measurements are as follows :—

Depth of shaft, 251 feet.

First level : At the first level the west drift is 308 feet, 2 inches, and the east drift from B shaft 243½ feet, making a total length of 900 feet along the level, including distance between the main and B shafts, and the lengths of the shafts. Stoping : No. 3, east stope (east of B shaft) ; length, 136 feet ; average height, 20 feet. An upraise from this stope has been driven through to the surface for ventilation at a distance of 140 feet from B shaft. No. 2, east (west of B shaft) ; length, 128 feet ; average height, 40 feet. No. 1, west (west of main shaft) : length, 91 feet ; average height, 28 feet : broken through to surface for ventilation at a distance of 75 feet from main shaft.

Second level : West drift, 106 feet. East drift, 178 feet. Winzes and upraises : (*a*) from first to second level at distance of 154 feet east of shaft ; (*b*) between same levels 68 feet west of shaft. Stoping : No. 1 East ; length, 52 feet ; average height, 15 feet. No. 1 West ; average length, about fifty feet ; stoped through to first level. Average width of all stopes, about 4½ feet. Underhand stoping from first level has been done at both winzes.

Third level. West drift, 96 feet, 4 inches. East drift, 74 feet. Upraise, 45 feet west of shaft ; 79 feet, 10 inches above drift. Winze directly above in second level, 9 feet 10 inches deep. The crosscut north from the shaft is utilized as a pump chamber, and a cistern has been sunk in same. There are three pumps in the mine ; one in the crosscut just mentioned, one in the bottom of the main shaft, and one in B shaft.

A new crusher and shaft house has been built at the main shaft. The building is 24 by 30 feet in size and 35 feet high. A new Blake crusher has been installed which has a capacity of 200 tons per 24 hours. Formerly the crusher was at the mill, but was changed when the additional 15 stamps were installed. The old crusher was a Comet B ; but this style does not seem to give the same satisfaction as the Blake. The crushed ore is raised by an elevator 38 feet 4 inches, to the ore bin, which has a capacity of 500 tons, and is provided with two gates. The crusher and the elevator are operated by a 16-h.p. horizontal engine.

A new gravity tramway with tail rope, has been constructed from the shaft to the mill, alongside of and replacing the old one. The length is 960 feet, and the slope, 1 in 23. There is one car with a capacity of 1½ tons.

The installation of the additional 15 stamps making 25 in all, with concentrators, etc., has been completed and the mill was in full running order at the time of inspection.

There are 3000 cords of wood piled up at the mill, and about 120 acres of the property has been cleared.

Instructions were left to replace broken stulls and remove insecure pieces of rock in the second level before continuing drifting or working under stopes in same.

FOLEY MINE

Operations have been resumed since March 3, 1900, at the Foley mine, after nearly two years' idleness. The old company had not the capital to enable it to continue work, so the property was sold to an English company, viz., The Canadian Mines Development Company, Limited ; capital, £300,000, in shares of £1 par value ; head office, St. Stephen's Chambers,

Telegraph St., London, England ; secretary, C. E. R. Betteley, Esq. Mr. Wm. M. Strong, manager of the Sultana mine, is consulting engineer in Canada for the company. The manager of the mine is Mr. O. B. Robinson ; total force, 16 ; number of miners, eight.

The programme of the new company is to open up and do considerable exploratory work in the North or Main shaft and No. 5 and Lucky Joe shafts ; and also to test what is known as the West vein, which is said to be traceable across one or two locations on the west side of the property. The North shaft is now 420 feet deep. It is to be sunk to a depth of 500 feet, and considerable crosscutting and drifting done to exploit parallel veins. The mill will not be run for some months, or probably a year.

The only part of the mine that had been re-opened up to the time of my visit was No. 5 shaft. It had been sunk by the old company to a depth of 90 to 100 feet, and at a depth of 50 feet a drift had been driven north 48 feet, and one south 94 feet along the vein. A little over hand stoping had been done at the shaft in both drifts. The shaft is now 212 feet deep, and 7 by 9 feet in size. It follows the vein with a dip of about 80 degrees east as far as the first level, below which point the vein does not appear, and the shaft below this has been continued vertical. At a depth of 205 feet a crosscut, 6 by 6½ feet in size, has been driven west 60 feet, and is being continued. At a distance of 20 feet from the shaft a vein of quartz 7½ feet wide has been passed through.

Two No. 2 drills are employed. Air is supplied by the large compressor at the mill. Drainage is secured by bucket. There is no new machinery so far. The old No. 5 hoist has been moved to a new hoist house on the opposite, or south, side of the shaft. It is a duplex, and of sufficient capacity to do all the necesary exploration work in this shaft. The cable is of ¾-inch diameter, steel wire. A steel bucket is employed. A pole skipway extends to the bottom of the shaft. The shaft house is 30 feet high. A new tramway 90 feet long has been constructed on trestle 14 feet high, and extends east from the shaft.

A new Inspector's book was left as the old one could not be found. The following entry was made regarding the condition of the mine, and instructions given. "(1) Some insecure masses of rock were found on the walls of the shaft. Keep shaft carefully scaled. (2) The ladderway is not provided with platforms or division above the first level. Below this it is constructed with these requirements for a depth of 70 or 80 feet, and with platforms and no division for the remainder of the distance to the bottom. Construct the ladderway according to the Mines Act above the first level. Continue the division as far as the lowest platform below the first level. Provide sufficient space for men to reach the second ladder below the first level. Reduce the size of the man-holes in the two lowest platforms. (3) Provide guard rail around hoisting compartment at first level, and also at all sides of shaft on surface."

Date of Inspection, June 28.

GOLDEN CRESCENT

The Golden Crescent has been working steadily since last report. The foreman is Thos. Peller ; total force, 24 ; number of miners, eight.

The recent developments measure as follows : Depth of shaft, 200 feet. Third level ; depth, 193 feet ; east drift, 95 feet ; west drift, 70 feet. Size of drifts, 4 to 4½ feet wide by 7 feet high. Sinking was discontinued at the time, but was to have been resumed at once. Drilling was done by hand in one drift, and a machine drill operated by steam was employed in the other. Steam is an economical power for drilling, but it heats the workings up to an uncomfortable extent, even when the exhaust is piped up, and not allowed to escape below. In this case the exhaust escaped a short distance above the bottom of the shaft.

The vein is 12 or 13 inches wide at the ends of the drifts, and averages three or four feet between, forming a fair sized ore shoot. The values are said to be very good.

Drainage is secured by a pump at the bottom of the shaft. Ventilation is poor at the third level, and aspirator pipes were recommended. The ladderway extends to the bottom of the shaft, and conforms to the requirements of the Mines Act, but is very poorly constructed.

A new blacksmith shop has been built adjoining the hoist house.

Date of inspection, June 25.

RANDOLPH MINE

Operations have been resumed at the Randolph after suspension since April 20. The manager is Neil Berger, and the force consists of two miners and an engineer. The underground measurements are as follows: Depth of shaft, 210 feet. First level; west drift, 50 feet; east drift, 23 feet. Second level; depth, 200 feet; west drift, 30 feet 8 inches; east drift, 21 feet. The shaft had just been pumped out and mining work commenced on the day of my inspection. A crosscut south has been commenced at the second level, close to the shaft. The vein almost disappears below the first level, but comes in again lower down, showing a width of 3½ or 4 feet. It is about 2 feet wide at the second level at the shaft, but narrower at the ends of the drifts. The ladderway is suitably constructed as far as the second level, with the exception that there is no division below the first level. Instructions were left to provide this.

Date of Inspection, June 25.

ISABELLA MINE.

Mr. Berger, who is also manager of the Isabella Mine which has been closed down since last fall, informed me that the shaft had been sunk to a total depth of 65 feet. A horse whim has been put in this spring and camps built with the expectation of resuming work soon.

MANHATTAN MINE.

On June 25, I visited the Manhattan and found the mine closed down awaiting examination by an expert, Mr. John E. Hardman of Montreal, before a definite policy with regard to future operations would be decided upon. Work ceased on June 1, and Mr. Hardman was expected any day afterwards. He arrived while I was in the vicinity. Mr. Frank Peterson, the manager, was at the mine, and an engineer had been retained to keep the shaft dry.

The ore body is a large quartz vein. The shaft was commenced on what was believed to be the vein proper; but developments showed that it was sunk in the foot wall, following the dip of the vein and passing through portions of it where the irregularities of the latter manifested themselves in a variation of the dip or in an increase of width. Accordingly crosscutting was required at each level to reach or to pass through the vein.

Shaft: The shaft has been sunk to a total depth of 325 feet.

First level: No further work has been done in the first level since last report.

Second level: The second level is at a depth of 200 feet. A crosscut has been driven south 32 feet, and a drift at the end has been driven 8 feet east.

Third level: The third level is at a depth of 265 feet. Crosscut, 37 feet south. Drift, east; 112 feet, at distance of 16 feet from shaft.

Fourth level: Depth of fourth level, 325 feet. Crosscut south, 32 feet. Size of all crosscuts and drifts, 6½ feet wide by 6½ to 7 feet high.

The vein is a little irregular at the first level, but there is 12 feet of quartz. At the second level it is 18 feet wide, all quartz; at the third, the vein is irregular, with 26 feet of quartz, and at the fourth it is 26 feet between walls, all quartz. There are rich streaks of dark colored, well mineralized quartz carrying galena, zincblende and other sulphurets, but the main body, or greater portion is white quartz, rather low grade.

Drilling had been done by steam for the greater part of the work, but since the closing of the Decca, an adjoining property, compressed air was piped over from this mine for the last part of the development work.

The ladderway extended for only a portion of the distance, and was of no use when working in the lowest levels. It was not cased off from the hoisting compartment or provided with platforms, according to instructions.

Mr. Peterson informed me in August that he was going to re-open the mine immediately, and do some drifting and other exploratory work on the third level.

DECCA MINE.

The Decca mine was closed down while I was in the vicinity, but I learned later, in August, from Mr. Frank Peterson, manager of the Manhattan mine, that mining operations were to be resumed under his management immediately, and that a mill was to be erected.

LUCKY COON AND ALICE A MINES.

The Lucky Coon and Alice A. properties were both closed down at the time of my visit to that locality.

MAYFLOWER MINE.

The Mayflower mine consists of locations K 390 and 391, which contain 40 acres each, situated about 10 miles east of Sturgeon Falls on the Lower Seine. I made the trip by canoe up the Seine from Mine Centre in less than a day on June 29, and returned on the following day. There are two short portages on the river, and a five mile trail from the end of the canoe route. The new railway will pass within about half a mile of the shaft The property is owned by the Rainy River Development Company of London, Limited ; capital, £300,000 The manager of the mine is Arthur W. B. Whitely. The total force is 11 ; number of miners, 8.

The formation is chlorite schist, with a strike of nearly north and south. A small mass of intrusive granite comes in within 100 feet of the shaft.

The main vein has a vertical dip, and a strike of north and south. It is traceable for over 100 feet in a straight line, and about 70 or 80 feet north of the shaft it appears to bend sharply to the east, according to outcroppings that are found at intervals, but it is impossible to be certain without more stripping. It is about six feet wide in the shaft, consisting of quartz and schist mixed, with rather indefinite walls. On the surface it is exposed in one place 10 or 12 feet wide. Leaf iron pyrites is quite plentiful, and zincblende occurs also in small amounts.

A 7 by 9 foot vertical shaft has been sunk to a depth of 90½ feet on the vein at the point where the latter crosses the boundary between the locations. A suitable collar has been constructed to a depth of 17 feet. At a depth of 43 feet there is a sub-level, with a 6 by 6½ foot drift 13 feet north, a 4½ by 6½ foot crosscut west 32 feet and a crosscut east 5 feet. Work has been discontinued at this level. The first level is at a depth of 75 feet. There is a drift north 34 feet, which has been dammed up at the entrance and utilized as a pump station, and a No. 4 Cameron pump installed. A drift has been driven south from the shaft in the same level 8½ feet.

Mining work was suspended just the day before my inspection, owing to the encountering of a flow of water, which could not be handled satisfactorily by the present pump, but the delay should not last very long. The mouth of the shaft is at a sufficient elevation to give good dumping facilities. The hoisting plant consist of the following : duplex, 5 by 8 inch hoist, ¾-inch steel wire cable, 750-lb. steel bucket, 36-inch sheave, 20-foot head frame, economically and neatly constructed, and a 30-h.p. locomotive style boiler. Blasting is done by battery.

The following buildings are on the property : boarding and sleeping camps, old camp, hoist house, blacksmith shop and powder house.

The following instructions were left in the Inspector's book : "(1) Scale shaft carefully ; some insecure masses of rock were found. (2) Provide guard rail at shaft mouth. (3) Construct ladderway as far as the 75-foot level according to the Mines' Act."

HIDDEN TREASURE MINE.

The Hidden Treasure mine is a property belonging to the same company that owns the Mayflower. It is situated on the trail to the Mayflower, about $1\frac{1}{2}$ miles from the latter, and consists of locations HP 278 and 279, containing 40 acres each. The formation is green schist. The vein is in a band of much altered and heavily mineralized hydromica or felsite schist, some of which is salmon colored, but most of it light grey. The mine was worked from Oct., 1899, until the end of the year. The shaft was full of water at the time of my inspection. Mr. A. W. B. Whitely, who gave me the information regarding same, was manager. He informed me that the shaft, which is on HP 278, is 64 feet deep, with a crosscut 16 feet south at a depth of 54 feet. The size of the shaft is 6 by 8 feet. It is vertical for 18 feet, and dips 65 degrees north below this.

Date of inspection, June 30.

Lake Superior Region.

URSA MAJOR MINE.

The Ursa Major mine, which has been mentioned in previous reports, is owned by the Jackfish Bay Syndicate Mining Company, Limited ; head office, 23 Toronto Street, Toronto ; capital, $1,000,000 in 200 000 shares of $5 each ; president, J. M. Staebler, Berlin, Ont. ; vice-president, A. Ogden, Toronto ; second vice-president, A. J. H. Eckardt, Toronto ; secretary-treasurer, F. J. Beharriell ; managing director, C. B. Jackes, corner Court and Church Streets, Toronto ; Mr. J. P. Williams, formerly of the Saw Bill, has been superintendent of the mine since November 21, 1899. At the time of inspection the total force was 7, including 3 miners. Some of the officers of the company were visiting the property at the time of my inspection, and they were rather undecided as to their future policy, hence the small force at the time.

The main shaft has been sunk to a total depth of $121\frac{1}{2}$ feet. At a depth of $118\frac{1}{2}$ feet a crosscut has been driven north $88\frac{1}{2}$ feet. Work in the shaft was discontinued. The crosscut was driven to cut the series of veins which outcrop north of the shaft, as described in previous reports. But, strange to say, no quartz was encountered, although there are favorable indications such as zones of mineralized, schistose matter. It would, however, be most advisable to continue the crosscut farther. The ladderway in the shaft has been suitably constructed, with platforms and division as far as the $118\frac{1}{2}$ foot level.

About 400 feet northeast of the main shaft a vein called the "Lizard" vein has recently been discovered, which is by far the best showing on the property, and is an excellent looking proposition. It has a strike of north 78 degrees west, and has been stripped for 112 feet. A width of over 20 feet has been revealed, and the indications, from the indefinite nature of the walls, are that it is wider. There is an average of about 15 feet of quartz. A "horse" of dark, micaceous schist, 3 to 4 feet wide comes in at the upper, or west, end of the outcropping, or stripped portion, and this changes to an irregular inclusion of hornblendic rock farther down. At the west end stripping can be carried farther, and probably will be, as evidence of continuity is undoubted. At the east end stripping could not be continued owing to the vein dipping into low ground, and under Lizard lake, but the vein looks stronger and more definite at this end, and underground developments should make a good showing there. There is a gorge following the strike of the vein on the opposite or east side of the lake, which is about 200 yards across,

and the vein can be plainly traced for over a quarter of a mile down this gorge to where it again dips into low ground at another lake. The best part of the vein, however, is that which was first mentioned. Copper and iron pyrites and considerable quantities of galena are found all through it ; and assays of gold and silver are said to be exceptionally good. The quartz is very good-looking. Open cutting is in progress on the stripped portion ; about 2,000 tons of quartz has been blasted out.

Stripping has been done at a number of other places on the property, showing the same to contain a series of nearly parallel, but apparently converging, veins, scattered over a width of several hundred feet between the main shaft and the Lizard vein. An immense amount of ore is shown to exist by these surface exposures, and assays from same are said to be satisfactory. Galena is found in a number of the outcroppings.

The following machinery is on the property, but not yet installed : A 75-h.p. Waterous engine, 35-h.p. locomotive style boiler and two steel buckets of 3,000 lbs. capacity each. There is a steam hoisting plant at the main shaft.

Date of inspection, May 21.

JACKES AND M'FARLANE PROPERTIES.

I remained several days at the Ursa Major mine, and while there examined some properties in the vicinity. One large vein, which was characteristic of many veins in the Jackfish Bay country, lies about a mile or so east of the Ursa Major. Four locations, R 686, 689, 690 and 691, containing 40 acres each, and owned by C. B. Jackes of the Ursa Major and Alex. McFarlane of Port Arthur, have been taken up along the vein. The latter has a strike of about 10 or 12 degrees north of west. I walked along it for about a quarter of a mile, but it is said to be traceable much farther. It follows a ravine, which owes it origin, no doubt, to a large fault in the country. The vein averages about 10 or 12 feet in width, as far as I could determine. Assays obtained from it were said to be very satisfactory. It contained galena and pyrites.

THE POLARIS LOCATION.

On May 25 I accompanied Mr. C. B. Jackes and the other members of the party, including Mr. Staebler, Mr. Eckhardt, Mr. Croft and Capt. Williams from the Ursa Major, on a trip to Mountain lake, which is about 6 or 7 miles north of Jackfish, and while there examined M 23, a location containing 347 acres and occupying an elevated, mountainous point of land on the lake. It has been named the "Polaris" on account of its topographical features. The location was not patented, but had been applied for by Mr. Jackes at the time of our visit. The formation is greenstone. A huge vein crosses the property with a strike of north 45 or 50 degrees west. I walked along it for about a quarter of a mile, examining it where it outcropped or was exposed, which was at frequent intervals. It is in reality a large felsite dike in which the dike matter has been replaced more or less by quartz at different points. In one place it measured 40 feet between walls. This was about the only place where both walls were exposed. Some of the exposures are nearly all quartz, in other places the quartz is intimately mixed with the felsite, or dike matter, and in some places the felsite predominates. The outcropping all along is at a considerable elevation above the lake, hence a large portion of it could be cheaply mined, and if it averaged between two and three dollars per ton it would be a very good proposition. A little blasting has been done at several points.

M'QUAIG AND DAVIDSON PROPERTIES.

On May 20 I walked over locations R 692 and 693 and HP 467, owned by John McQuaig of Jackfish and John Davidson of Port Arthur. The former acted as guide in my examination. The three locations adjoin and are on the road to the Ursa Major mine, between three and four

miles from the steamboat landing on Jackfish lake. The formation of all three is greenstone. R 693 contains 270 acres. There is a vein which is exposed for 40 or 50 feet, and is traceable by outcroppings at intervals for a much greater distance. It is about 8 feet wide, with $3\frac{1}{2}$ feet of solid quartz, the rest being a mixture of quartz and greenstone. The quartz is said to assay $5.80 per ton. HP 467 contains 187 acres. On it there is a quartz vein 6 or 7 feet wide, with rather indefinite walls. A test pit has been sunk 4 feet in it, and is being continued. The assays are said to be $3.75 in gold and $2.50 in silver. There is another vein on the same location one to two feet wide, on which an open cut has been made 10 or 12 feet into the hill-side. On R 692 a shaft has been sunk 24 feet, but it was more than half full of water at the time of inspection. There is about 4 feet of quartz, and the vein is about 6 feet wide between walls. Much of it is decomposed schistose matter. It is said to average $3.50 all across.

EMPRESS MINE.

I visited the Empress mine on May 22. Mr. Waters, who was foreman at the time of working, was looking after the property. He informed me that operations had ceased on Dec. 20, 1899; also that drifting in the winze had been carried 50 feet along the vein in each direction since my last visit. The winze was full of water at the time of inspection. A diamond drill is on the property, but only nine feet of drilling has been done There has not been sufficient work done on the property to test it: it is a good prospect for a company with sufficient money to do considerable development work and erect a much larger mill. Lack of funds was the cause of the shut down.

LEO MINING COMPANY'S PROPERTIES

In the report of the Bureau for 1897 there is contained a description of a property belonging to Dr. Emory of Toronto and J. E. Newsome of Port Arthur, and consisting of locations 590, 591 and 592X, situated four or five miles west of Middleton, or 10 or 12 miles east of Jackfish, on the C P. R. Hearing that work had been commenced on the property, I went down on May 27 to McKellar's bay, which is about $2\frac{1}{2}$ miles west of Middleton, and is the point on the railway from which the trail leaves for the property about $2\frac{1}{2}$ miles north. Mr. Julius Hirshfeld, general manager of the new company which had taken hold of the property, was camped on the bay close to the track, with a party of road cutters, and preparations were being made to commence exploratory and test work. The road was being cut through, and when this was completed and camps were erected on the locations mining operations were to have commenced. Mr. Hirshfeld presented me with a prospectus from which I obtained the following information: The property is owned by The Leo Mining and Development Company, Limited; capital, $5,000,000 in shares of one dollar each; New York office, 149 Broadway, Room 217, New York; president, Henry Somerset Cates; first vice-president, Hon. Arthur Sturgis Hardy; second vice-president, W. T. Niswanger; general manager, Julius Hirshfeld; consulting engineer, Wm. Wirt Chipman.

Extract from prospectus: "It is the intention of the company to take immediate steps to sink a large, double compartment shaft at the point where No. 3 and No. 4 veins cross each other at right angles . . . . . etc."

The three locations, according to the prospectus, have been subdivided into 32 claims of 10 acres each.

SLATE ISLANDS

The Slate islands are situated about 7 or 8 miles out on Lake Superior from Jackfish. They belong to Lieut.-Governor J. C. Patterson of Manitoba. Two prospectors had been engaged exploring them for the greater part of the past two or three years, and mining work has been in

progress since December, 1899. I made two trips in a fisherman's small steam launch to the islands. The first time we could not find the place where the work was going on, but the second time, which was on May 23, we were more successful. The mine is on the west side of South island, facing the open lake, and about 12 or 13 miles from Jackfish. The landing is very poor on account of the shallow water and the rock bottom, and there is no shelter from southwest winds on the lake.

The formation at the place where the work is in progress consists of belts of conglomerate and of hard, fine grained, green schist, with a strike of northwest and southeast. Two tunnels, about 400 feet apart, have been driven nearly parallel into the side of the hill at an elevation of 6 or 8 feet above the level of the lake. No. 1 tunnel, driven east 26 feet, and 4½ by 7 feet in size, has been discontinued. The vein, which has a strike of nearly north and south, crosses the tunnel at the mouth. It consists of two bodies of quartz aggregating 5½ feet. No. 2 tunnel (of same cross-section as No. 1) has been driven southeast 159 feet, and is continued. It is expected that the vein crossing No. 1 tunnel will be reached at a distance of about 15 feet further. There is a large " vein " crossing No. 2 tunnel at the mouth, about 80 or 90 feet of which is passed through by the tunnel. It consists of a peculiar mixture of white, opaque quartz, jasper and greenschist. I did not remain more than two hours on the property, and hence did not attempt to investigate the deposit with a sufficient thoroughness to determine the nature of it, but it appears to be of eruptive origin. Whether it carries sufficient gold or silver to be considered an ore has not yet been determined.

A number of test pits have also been sunk at points all over the islands. Thos. Davis is superintendent of the work. The force consists of 6, including 4 miners.

M'KELLAR'S MINE.

On May 30 I walked from Schreiber to a property about three miles south of the railroad known as McKellar's mine. An old trail to the lake is utilized as far as possible, and a branch trail has been cut thence to the mine, making the distance by this roundabout way from 3½ to 4 miles. The property is owned by Peter McKellar of Fort William. Work has been going on since April 15. C. H. O'Neill is foreman and contractor, and the force consists of four miners and a cook.

The formation is trap. A 4 by 6 foot tunnel has been driven 60 feet west on a small, but rich vein from 6 inches to 4 feet wide, the wide part consisting of a mixture of quartz and trap. The dip of the vein is about 50 degrees south. The quartz is white and bluish, and contains copper and pyrites and visible gold. The vein matter from the tunnel is said to average $283 per ton by assay.

About 45 feet above the tunnel an open cut has been made on the vein about 20 feet long, and about 10 feet deep.

There is another vein south of the first, and apparently forming a junction with it at a short distance beyond the mouth of the tunnel, where a test pit has been sunk 8 feet. This vein has a dip of about 65 degrees south, and a strike of nearly east and west. It consists of a mixture of quartz and dark colored felsite. A series of test pits has been sunk at intervals along it. One of these is a short distance above the open cut on the first vein. The vein shows a width of about 5 feet in the pit.

The only building on the property is the boarding camp.

OTISSE SULPHUR MINE.

This property is from a mile and a half to two miles north of Schreiber. The first mile is by road leading to Cook's lake which is crossed by canoe, the distance being about three-quarters of a mile. The property adjoins the lake. It consists of two locations, 776 and 777 X,

aggregating 208 acres, and is owned by Messrs. J. E. Walker, S. Otisse and G. D. Mudge, all of Schreiber. Mr. Otisse guided me to the property, and showed me over it on May 30. We walked over 776 X. The formation is greenstone.

We first examined a test pit which had been sunk several feet on an outcropping of quartz which was exceptionally good looking. Mr. Otisse informed me that the outcropping was of considerable extent, over 100 feet wide and traceable for a considerable distance, but that the values were low. As the country had been recently swept by fire and the rock was not exposed in the vicinity of the pit conditions were not favorable for an examination of the deposit but judging from what I saw in the pit and from what Mr. Otisse told me of the size I would say that it was a remarkable deposit, well worth exploiting. Only one assay had been made, and this would give very little information of so large a deposit.

The sulphur, or pyrites, deposit consists of a mineralized zone with an oxidized capping outcropping along the hillside where the rock is more or less exposed. It is said to be traceable for over a mile, with a strike of nearly east and west. We walked along it for several hundred feet examining exposures which occurred at intervals. Test pits have been sunk at several points, and a couple of these were inspected. One was 12 feet deep, 12 feet long and 6 feet wide. The deposit is heavily impregnated with pyrite on the surface, and lower down the percentage of that mineral increases, until it occurs in almost solid masses. There is said to be a solid body several feet wide at bottom of pit, but water prevented examination. The dump looked very encouraging. Pyrrhotite occurs in masses or veins in the deposit, but it is not mixed with the pyrite.

GREAT GRANITE COMPANY.

On May 31 I stopped off at McKenzie, a flag station about 14 miles east of Port Arthur, to visit a property on the railway about two miles west of the station The camps are about 50 yards south of the track. I walked in about three-quarters of a mile south from the railway along a well-beaten trail, and encountered a shaft in which work had been recently suspended. It had a depth of 30 or 35 feet and a dip of about 50 degrees north. The vein is about two feet wide, and consists of a curious mixture of quartz and greenstone, not unlike in appearance the veins in the silver district further west. The formation is hard, fine-grained greenstone, with granite coming in north of the shaft. North of the track and just east of the camp a test pit has been sunk 7 feet and discontinued. It is 8 by 16 feet in size, and is sunk on a large body of quartz and country rock mixed which is said to be traceable for a long distance. I was informed by the manager of the property, Mr. Walker, that they found they were not on their own location when sinking this pit. He also informed me on meeting him after leaving the property that they were working about half a mile east of the first mentioned shaft, on the same lead. The force consisted of two miners. The property consists of two locations, 4A and 5A, and is owned by Jas. Chamberlain of Toronto. It is being operated under bond by The Great Granite Gold Mining and Development Company, of Ontario, Limited. Work has been going on since November, 1899.

RAT PORTAGE REDUCTION WORKS

The Rat Portage Reduction Works milled 200 tons of ore from the Wendigo mine this summer ; and the staging at the railway for receiving ore by rail has been rebuilt. Mr. Alexander M. Hay is manager.

KEEWATIN REDUCTION WORKS

The Keewatin Reduction Works milled 100 tons of ore from the Champion (formerly known as the Bad) mine this spring ; and they are now preparing to treat 1,000 tons from the Wendigo immediately. The works will therefore be running steadily for several months.

The Ottawa Gold Mining and Milling Company, Limited, owner of the Reduction Works, has bought the Golden Whale mine, or H W 416, in the New Klondike. This property, which has been described in previous reports, belonged to Hon. Robert Watson of Manitoba, now of the Dominion Senate, and Mr. J. M. Munro, of Dinorwic. These parties have several weeks in which to decide whether to retain a small interest or to sell out entirely. The deal was made in April last. A branch or spur of the C.P.R., standard gauge, is being built to the mine, a distance of about 7 miles from Dyment station. Mr. H. A. Guess, the company's manager, returned from the mine on July 6, and informed me that the road would soon be completed. The ore will be shipped directly from the mine to the reduction works at Keewatin, a distance of about 130 miles by rail. The following machinery is at Dyment, awaiting to be installed at the mine: The high pressure half of an Ingersoll compound compressor, with 18 by 24 inch cylinder; seven drills; four No. E, two D and one A; a duplex 8½ by 10-inch cylinder hoist, with double drum, 30 inches in diameter, and two 80-h. p. boilers.

MINES OF NORTHWEST ONTARIO: PART II.

REPORT BY W. E. H. CARTER, B.A.SC

I beg to herewith submit my report on the mines of Northwestern Ontario as I found them on a trip of inspection in December, 1900, and January and February, 1901.

Following instructions received I left Toronto, December 18, 1900, returning two months later after having visited nearly every working mine in the region as well as many that were closed down. A good deal of time was consumed simply getting in and out of some of the districts for in the winter season after leaving the railroad, stages are practically the only means of conveyance over land or lake. A year hence however ought to see the completion of the new Ontario and Rainy River Railway which will give easy access to the southern part of the region from end to end, now difficult to reach at any season of the year. To the railway can be attributed the opening up of many mines in new districts, which helps in some measure to offset the large number of shut-downs that have taken place recently at mines all over northwestern Ontario. The causes of these stoppages are no doubt numerous, only one of them that the property may have proved valueless. However, as a result the mining industry is dull at nearly all centres; but hope is sustained that the spring and summer will as usual see a revival in the old mines and also bring forth their quota of new.

Lake of the Woods Region.

This region was fairly active last year, 1900, until the late fall when most of the mines closed down, and now the Sultana and Stella together with a few prospects are the only properties in operation. Indications point toward some revival of the industry with the spring and summer months.

SULTANA MINE

I visited the Sultana mine January 31st, 1901. It keeps working along steadily as usual, the only recent changes to note being that mining operations are now centered chiefly on the Crown Reef vein, and that since October 1, 1900, the stamp mill runs have covered only from 16 to 11 hours instead of twenty-four hours per day for the six days of the week. The working force remains about the same as before, being 60 in all, of whom 34 are miners.

Following is the record of work done since the last report:—

Main shaft: first level, south drift, at Galena shaft; stoping, north side of shaft; length, 90 feet; height, 81 feet, from the level up: south side of shaft; length, 60 feet; height, 49

feet, from 32 feet above the level ; width of both stopes, 4 feet. A pillar of ore is left on both sides. At 70 feet south of main shaft, underhand stoping was just commenced on a block of ore overhanging the old stope to the south, the ore to be left on the stope timbers below as a reserve.

Second level, south drift: branch drifts at Crown Reef vein ; west, 136 feet ; south, 30 feet ; east, 38 feet. At face of west branch, crosscuts ; north, 5 feet ; south, 31 feet ; also an upraise, 60 feet, with a stope on either side to the top, length, 20 feet ; width, 4 feet. East branch at 22 feet in a winze ; depth, 34 feet ; size, 6 by 10 feet ; inclined 80 degrees north ; being sunk to connect with the fourth level south drift. Stopes : on Crown Reef vein above east and west branch drifts and on both sides of the old south air shaft : west side : average length, 53 feet ; height, 90 feet, from the floor of old open surface stope or trench above, down. East side ; average length, 70 feet ; height, 126 feet, from floor of surface trench down to the level. Average width of stopes, about 4½ feet. A small air hoist is installed on the level, close to the winze, working the bucket in the same.

Fourth level : south drift, length, from face of old stope, 466 feet, being driven to meet the second level winze on the Crown Reef vein.

Fifth level, north ; the old stope down to sixth level has been filled with waste rock.

Seventh level ; north drift, length 332 feet ; discontinued January 1, 1901.

There are five air drills in use underground at the four working faces : one stoping in first level, south ; two stoping on Crown Reef vein above second level ; one sinking winze on Crown Reef vein from second level ; and one driving the fourth level south.

STELLA MINE.

This mine lies in the Witch Bay district. In January the mine was pumped out again and prepared for resuming operations regarding which the following information was obtained from the manager, Neil Campbell: A syndicate from St. Paul, Minn., has secured a working option on the property and has already let a contract for the mining work, for the carrying on of which they are now purchasing machinery consisting of pumps, hoist engine, bucket and boiler. The shaft is to be sunk from its present depth of 127 feet to the 200-foot level and from there exploratory drifting will proceed. The force now numbers 10 miners.

REGINA MINE

As to this mine the following information was received from Mr. J. F. Mieville, the late manager : Mining has not yet been resumed since it ceased in October, 1899. However, all the underground workings have been and are now kept pumped dry in anticipation. Three separate examinations and reports have been made on the property by mining engineers for outside capitalists, by whom the mine has been held under option for a sale. The option expires this spring, but so far nothing definite regarding future operations is known.

KEEWATIN REDUCTION WORKS.

Since September, 1900, the 20 stamps have dropped almost continuously full time, the ore put through consisting of a lot of 1,000 tons from the Wendigo mine, Witch Bay ; 554 tons from the Champion or Bad mine, east of Rat Portage ; and ore from the Sakoose mine, which was recently purchased by the owners of the Reduction Works, The Ottawa Gold Milling and Mining Company. The Sakoose is now shipping to Keewatin regularly, though as yet not in sufficient quantity for a continuous 20-stamp supply, so that the works are still open for custom trade.

RAT PORTAGE REDUCTION WORKS.

The services of this plant have not been made use of since last summer, but it is still ready and open for business.

Shoal Lake Region

In the region of Shoal lake or Bag bay the only mine working in January, 1901, was the Mikado. Most of the others were in operation during the year 1900, but one after another they have closed down. The Sirdar ceased work about August, 1900, and since then the compressor and air drills have been sold. The Crown Point after a few runs in the new 5-stamp mill closed September 25, 1900. The Cameron Island mine was kept drained until the winter set in, in the anticipation of resuming operations at any moment.

MIKADO MINE.

Since last summer very active operations have been carried on at this mine with the result that in a short time numerous changes have taken place. A new skip road has been built down through the old stopes running straight for 580 feet, when it gradually swings 15 degrees to the east, continuing to a total length of 805 feet, with a vertical depth at this point of 395 feet. The road follows close to the bottom of the stope on an average incline of 27 degrees, the minimum being 22 degrees and the maximum 32 degrees. In this necessary grading and straightening of the line and tunnelling some 3,000 tons of rock, about half ore, had to be removed. The gauge of track is 42 inches and weight of rails 30 lbs laid on 8 by 10-inch stringers on stulls with 8-foot centres. The steel skip weighs about 2,600 lbs. and the rope used is $\frac{7}{8}$-inch steel.

Following are measurements of the new mining work done to date, obtained from the plans :

No. 1 shaft ; abandonded temporarily.

Incline shaft ; depth, on incline, 805 feet ; vertical, 395 feet ; dip, 27 degrees. Fourth level ; north drift, at No. 1 shaft, a winze, depth 20 feet. Fifth level ; vertical depth, 300 feet; south drift, 240$\frac{1}{2}$ feet ; at 80 feet from incline, a winze, depth 69 feet, through to sixth level. Sixth level ; vertical depth, 370 feet ; south drift, 104 feet ; at 95 feet in, a winze, depth, 12 feet. Seventh level, vertical depth, 395 feet ; south drift, 10 feet ; north drift, 10 feet.

Stoping (given in cubic feet) : No. 1 shaft : First level ; north, 1,530. Second level ; north, 7,430 ; south, 11,443. Incline shaft : Third level ; north, 11,506 ; south, 8,700. Fourth level ; north, 4,200. Fifth level ; south, 27,535. Sixth level ; south, 3,247. Stoping is still going on in the sixth level, but above the fifth the ore chute is all cleaned out to the surface.

No. 2 shaft ; re-opened about December 1, 1900. First level ; north drift ; underhand stoping from 15 feet in, length 50 feet, depth 6 feet, width about 6 feet. Second level ; south drift at 145 feet in, a winze, depth 45 feet, size 7 by 8 feet. A hoist engine, head gear and bucket are now being installed here and when complete, sinking in this winze will continue. At the shaft, second level, a pump is being installed to drain from both drifts, from sumps and from the shaft, the sinking of which is also to be carried on at once. The ladderway in this shaft has no platforms, nor is it cased off from the hoistway for 30 feet at the first level and for a distance above the second. Instructions were left to timber these in and to place a guard rail round the shaft at the first level. No. 2 vein ore is trammed along the surface about 500 feet and dumped into a large bin constructed just below the surface in the old stope in No. 1 vein, over the skip road and convenient to the skip, in which it is subsequently hoisted along with No. 1 ore.

The old ore reserve being exhausted, the supply for the last mill run has had to be drawn from all working faces, namely, from the incline shaft sinking, the seventh level drifts, the

sixth level stope and winze, and the winze in No. 2 shaft ; and this will continue to be the case until development gets ahead of the demand. The stamp mill however continues to run steadily full time for 6 days a week.

A shaft and crusher house has been erected at the mouth of the skip road and just west of the mill, in plan 48 by 48 feet and 70 feet high. The skip runs to the top, dumps either into a waste chute or over a grizzly into a bin ; thence the ore enters a 9 by 15-inch Blake crusher, after passing through which it is carried by travelling belt to a 7 by 9-inch crusher, and thence by a system of belts across and into the stamp mill bins. A horizontal steam engine operates this crusher plant machinery, all installed on the first floor, and in addition it will later on be connected with the machine shop plant to be set up on the ground floor. A new Lidgerwood hoist engine, 5-foot drum, double 12¼ by 15 inch cylinder, has been installed 75 feet south of the shaft house to hoist from the incline, the signalling being done by an electric bell service extending from here throughout the workings.

The other additions to the plant consist of two 125-h.p. return tubular boilers in a new house attached to the stamp mill ; a 100-light dynamo replacing the old 40-light machine ; a lathe and planer ; a 6-drill Ingersoll air compressor and five No. 3 machine drills ; two cyanide tanks, making eight in all ; and a centrifugal pump in the cyanide room for hoisting tailings to the tanks. Besides these the mortar blocks have been reset and all shafting lined up.

The new buildings in addition to those mentioned consist of boiler room, extension to cyanide house, hoist house, a very large three story boarding house and several employes' dwellings.

Following are additional instructions left in the Inspector's book : Shift the underground powder boxes into safe positions in accordance with the Mines Act ; place a solid hand rail down the skip road between the road and stairway.

The total working force numbers 80, of which 33 are miners. Superintendent, N. C. McMillan ; general manager, T. R. Deacon.

Date of visit January 26, 1901.

Lower Seine Region.

This region is dull just at present, for although most of the mines were in operation during the past year 1900, some of them continuing into December, they are all closed down now. The managers and those in charge of many properties are of the opinion that mining will be resumed there this spring or summer, and if this is so the prospects for the year are good. A few new locations were staked and prospected in a small way during the fall. I spent a week or more about the middle of January, 1901, in this district.

GOLDEN STAR MINE.

All operations were suspended at this mine on September 24, 1900. Since then the directors of the company have made endeavors to raise more funds to carry on mining, with the result that a charter has been obtained for a new corporation called the Golden Star Mining Company, Limited, to which the assets of the late Golden Star Mining and Exploration Company of Ontario, Limited, have been sold in consideration of shares in the purchasing company with ninety-five per cent. paid up thereon. An outline of the new mining work proposed by the directors of the new company in their published circular of date February 14, 1901, is as follows : Further development on the sixth level in the old mine or vein No. 1, together with explorations in other parts of the workings ; development of vein No. 2 ; subsequently a shaft may be sunk on the Randolph or No. 3 vein. The funds are to be obtained by calls on the stock to the extent of the remaining 5 per cent. assessable, to enable the directors to have operations resumed at the mine about May 1, 1901.

Measurements of the new mining work done to date of closing down were obtained from the plans, the mine being full of water :

Main shaft : fifth level ; north drift, 186 feet. No. 2 shaft: first level ; north-west drift, 28 feet ; south-east drift, 25 feet. Second level ; depth 87 feet ; north-west drift, 6 feet.

Stoping : main shaft ; first level north ; the old stope above the level extended 32 feet farther at same height, 38 feet. The block of ore remaining between first and second levels north removed, average length 40 feet, height 68 feet. Fifth level north : from 150 feet in stope was extended up to fourth level, height 47 feet ; length, at bottom, 75 feet, at top, about 20 feet. Consequently the open stope on the north side of the shaft now extends from 20 feet below the surface down to the fifth level or about 340 feet in height in all and with an average length of 125 feet.

Mr. H. H. Wood is in charge at the mine.

RANDOLPH MINE.

This mine was closed down November 18, 1900, for the reason, Mr. Neil Berger, late manager reports, that funds ran out. The last mining work done was driving the crosscut southwest at the 200-foot level from the shaft, a length of 63½ feet, at which point another vein was struck, supposed to be the continuation of the vein outcropping on the surface 50 feet southwest of the shaft.

OLIVE MINE.

Mining and milling operations ceased about July 1, 1900, but the mine was kept pumped out for a month and a half longer, since when, however, nothing has been done. Mr. W. A. Preston, who is in charge, reports that the company intend starting up again this spring and that plans for future development and working are now being drawn up for consideration.

DECCA MINE.

No further mining has been done since the close-down in the spring of 1900, but last fall a stamp mill was erected almost to completion, when this work also was suspended. The new building lies on nearly level ground 150 feet northeast of the main shaft with no connection as yet between the two for the transmission of the ore. Annexed to the east side of it is a large power room containing one return tubular boiler and two engines, one to run the stamps and vanners and the other the crusher. The mill machinery, supplied by the Jenckes Machine Company, consists of a Gates crusher, one 10-stamp battery, inside and outside amalgamation plates, and two Frue vanners with 6-foot belts. The plant has never yet been run. Mr. J. F. Mieville was manager at the time and superintended the construction of the mill.

FOLEY MINE.

The recent operations which began in March, 1900, continued on till December 15 when work was suspended. Mr. O. B. Robinson, the manager, was still resident at the mine when I visited it January 16, 1901, and expects that mining will be resumed again next spring and probably milling also. The following measurements of work done to time of closing down are from the plans, and the information regarding the veins from Mr. Robinson, the mine being filled with water :

No. 5 shaft : second level; east crosscut, 324 feet; at 20 feet from shaft, drifting, north 8 feet and south 8 feet ; at 140 feet, drifting, north 23 feet and south 10 feet ; at face, drifting, north 21 feet and south 12 feet ; west crosscut, 27 feet. Size of crosscuts and drifts, 6 by 7 feet. In

the east crosscut the first drifting was on a 5-foot vein ; the second on the Daisy vein, here 8 feet wide and almost vertically beneath its surface outcropping : and at the face the Lucky Joe vein was followed showing from 9 to 14 inches of quartz in the drifts. The west crosscut was driven to find the continuation of the Gold Panner vein whose surface outcropping lies 90 feet west of No. 5 shaft, and on the exposure of which some surface crosscuts were made during the year.

Eagle Lake Region.

Eagle lake and its vicinity is reached from the Canadian Pacific Railway from either Vermilion or Eagle River station. Not till 1900 was anything done in the way of mining beyond a little prospecting in this region. However, some good surface showings have now attracted the attention of both prospector and capitalist, and this winter several properties are being opened up, the character of the veins being free-milling quartz gold ores. It is most probable that a steamboat service will be instituted throughout the waterways here in the spring, running from Vermilion station down Vermilion and Portage bays into Eagle lake, thus greatly facilitating the handling of supplies. From all indications the coming season will be a lively one in this region. My inspections were made during the first week of February, 1901.

Swanson Gold Location

The Swanson gold location comprises the south half of lot 15, concession V, Aubrey township, and an adjoining 38-acre water lot, and is situated on the north shore of Eagle lake. Owners ; Geo. Swanson, L. Lawson and J. McAree, Rat Portage. In the summer and fall of 1900 a 6 by 10-foot vertical shaft was sunk on the property which, Mr. Swanson reports, is 57 feet deep and is in the vein for its full depth. The shaft was partially flooded and there were no ladders, but as judged from the surface and the dumps, the deposit is a highly schistose zone in the green trap rock containing a few scattered quartz stringers of about a quarter of an inch in width. Mr. Swanson informs me that at this depth of 57 feet (which is considerably below the level of the lake 50 feet distant) water was encountered flowing in such quantities into the shaft that they were forced to abandon it temporarily until machinery other than their hand windlass and bucket was procured ; and that steps were being taken to this end, so that mining might be resumed as early as possible this spring.

Manhattan Gold Location.

Locations DJ 2 and 3, situated on a point on the south shore of Eagle lake, 4 miles southwest of the Indian village, are owned by The Manhattan Gold Mining Company of Manitou, Ontario, Limited; head office, 16 Exchange Place, New York. During last fall a little surface work was done including the sinking of two test pits. No. 1 pit, to the east, depth 8 feet exposes a vein of fairly solid quartz 6 feet wide, with strike of about west 20 degrees south and vertical in dip, being between walls of a dark green trap. No. 2 pit is about a quarter mile to the west of No. 1, showing in its depth of 4 feet an area of dark colored quartzose schist 7 feet wide which contains irregular bands and stringers of clear quartz. There is a small amount of pyrites in both deposits of quartz. No camps have been erected as yet.

Eagle Lake Gold Location.

The Eagle Lake location is on an island lying two miles southwest of South Twin island, Eagle lake. The owners and operators are the Eagle Lake Gold Mining Company ; manager, Mr. Higbee, Rat Portage. Operations were conducted most of last year, the measurements of work done being as follows : Shaft ; depth, 60 feet ; size, 5 by 8 feet ; dip vertical. First level ; depth, 48 feet ; northwest drift, 28 feet ; southeast drift, 23 feet ; size of drifts,

4 by 7 feet. The shaft below the level is covered over and mining carried on only in the drifts. A rough shaft house has been erected and hoisting done therein by hand windlass and bucket.

The deposit is a true fissure quartz vein having a strike of about north 35 degrees west and south 35 degrees east, cutting across the north and south strike of the formation with vertical dip. As seen underground the walls are of an altered gneissoid rock and between this and the quartz lead lies a gouge often a foot or more thick and interbanded with small quartz stringers. The shaft follows the vein down and in it the quartz varies from one to two feet in width ; in the face of the northwest drift it is 20 inches wide, and in the southeast drift face 3 feet 8 inches The quartz varies in color from white to pink, containing but very little pyrites. The working force numbers 5 ; the only building is the boarding house.

VIKING GOLD LOCATION.

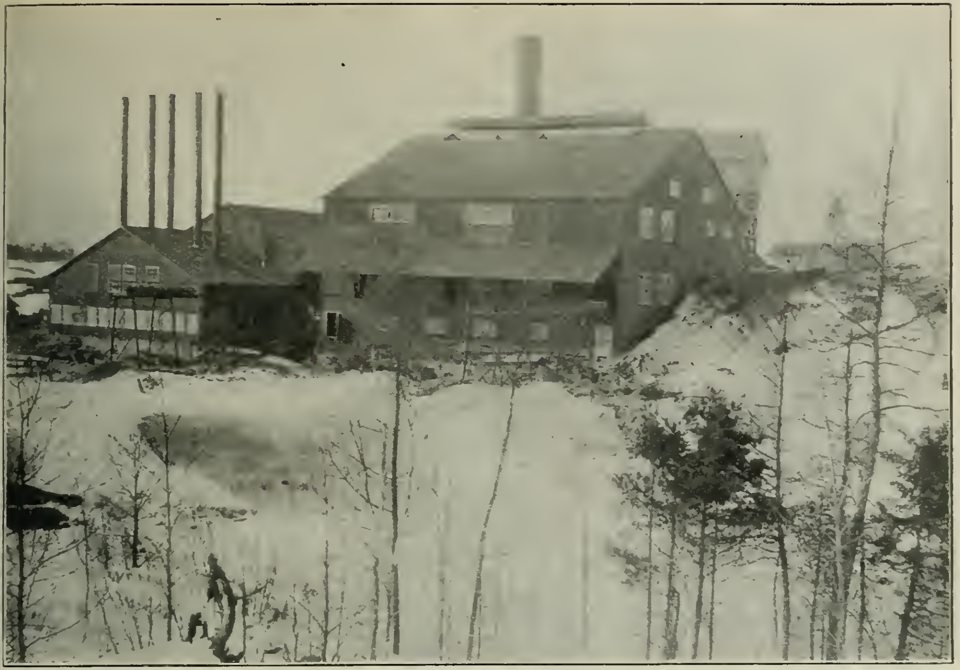
Location S 446, 25 acres, is situated on an island at the west end of Eagle lake. The owners and operators are E. Stevenson, L. Stevenson, F. Blackie and J. D. Curran ; address, Rat Portage. A force of two men has been engaged here since October, 1900, stripping and otherwise tracing veins and sinking test pits and a shaft. A contact between red granite and green trap runs northwest and southeast along the northerly shore of the island, the granite being on the southwest side. Quartz has been found along this line, but in the exposures now to be seen it lies in irregular masses in the granite a few feet back from the contact. Another vein striking east and west has been stripped at intervals for 700 feet west from this contact, one pit sunk on it about 400 feet west showing a deposit of green trap lying between walls of granite, dipping 60 degrees south, and interbanded with quartz stringers from a few inches to a foot or more wide, the whole 5½ feet wide. Other surface exposures on this vein exhibit the same trap with variations in the quantity of quartz contained, the latter in one place being at least 12 feet wide. At a point near the shore where this vein and the contact vein are supposed to intersect a shaft is being sunk, which has now reached a depth of 15 feet, first through 4 feet of drift and then into granite badly disjointed and capped in places with an overflow of the trap, but with no sign so far of any quartz vein or continuous fissure.

BADEN POWELL GOLD LOCATION.

Locations F M 167, 168, with two more. consisting of the whole of South Twin Island, Eagle Lake, have received the name of the Baden-Powell Mine. The owners and operators are a party of four : J. A. Partington, E. Appleton, S. Pinchon and S. S. Forneri, Rat Portage. Work has progressed here since November 3, 1900, confined so far to stripping the vein and sinking test pits. The vein lies in a formation of massive grey granite, with strike of north 35 degrees west and south 35 degrees east, with dip varying from vertical to a few degrees west. No. 1 shaft, 10 feet deep, exposes 7 feet of vein, of which 5 feet is solid quartz, and the rest an altered coarse schist lying on both sides of the vein. No. 2 shaft, or pit, 4 feet deep, and 330 feet along the vein to the north-west of No. 1 shaft, is sunk on 7 feet of vein also, but the quartz body has narrowed to 18 inches, the altered schist extending on either side to walls of massive granite. Between the two shafts the vein proper continues of fairly uniform width, but the quartz body is irregular, spreading from a foot to 10 feet in width. The quartz is finely granular, white and with only traces of iron pyrites, but showing at times on the surface and in the shafts free gold in uncommonly coarse grains. The working force numbers two ; the only building is the boarding house.

ELDORADO GOLD LOCATION

The Eldorado location is situated on a point at the southwest end of Eagle Lake This property was not inspected, but the following information was obtained from the



Victoria Mines : Reduction Works and Convertor Plant.

Part of Plant for Steel Mill, Lake Superior Power Company.

[14]

Rock Lake Mining Company : Approach to Mill.

owner and late operator, Mr. E. Gatensbury, Rat Portage. The mining work consisted simply of an open trench along the quartz vein, in length 70 feet, and depth 20 feet at face, the vein being 4½ feet wide. In the summer of 1900 a 2-stamp mill with amalgamation plates was installed at the mine, and during September all the rock from the cut was treated. At this point the funds ran out and work was suspended, and so far no plans have been decided on for the future.

Manitou Lake Region.

The mines now working in this region have all been opened up practically within the last year, all the older properties being closed with the probable exception of the Independence mine, at which it is reported a small force is preparing timbers for the erection of a stamp mill which was taken in there about two years ago. A new waggon road about three quarters of a mile long has this winter been cut over a point between Wabigoon and Little Wabigoon lakes, shortening the winter route over the lakes from Wabigoon to the Manitou by 5 miles. I visited this region during the early days of January, 1901.

MOOSE LAKE LOCATION.

Locations HW 6, 38 and 63, containing 140 acres, are situated ten miles south of Dinorwic and are surrounded by the waters of Little Wabigoon, Moose and Rice lakes and Grassy river. The owners and operators are The Moose Lake Mining and Milling Co., limited; head office, 71 St. Peter street, Montreal. President, David Robertson; vice-president, L. N. Depuis; secretary-treasurer, J. B. N. Chabot.

Previous to the sale of the property the original locators had sunk two shafts on HW38, one to the west, depth 20 feet, and one to the east of the claim, depth 40 feet, both of which were full of water at the time of my inspection, and on HW6 they had opened a surface crosscut 7 feet deep and 18 feet wide. Since then a new vertical shaft has been sunk by the present owners, at a point 75 feet north of the crosscut and between it and the old shafts; depth, 102 feet; size, 6 by 9 feet. According to a recent report on these locations by John Harland, M.E., there are two veins on HW 38 which converge and near the boundary unite, crossing the adjoining claim HW60 as one, the latter part being much wider than its branches, its dip vertical, and strike south 22 degrees west. The manager, Mr. Dryden Smith, informs me that the new shaft is on the junction of the three arms of the vein. The surface cut on the vein exposed a body of chloritic quartzose schist closely interbanded with lenticular masses of quartz, the whole containing a small percentage of pyrites. The cut shows two good walls 18 feet apart and beyond country rock of a dark quartzose schist similar to that seen in the few other exposures elsewhere on the locations. Mining had been temporarily discontinued to allow of the erection of the new buildings, and at the time there was no means of descending the shaft for a further examination.

The shaft house is 12 by 9 feet in plan, 30 feet high and enclosed; east of this 30 feet stands the engine house in which are installed a 25-h. p. vertical boiler and a 5 by 5-inch double cylinder hoist with 270 feet of half-inch steel rope for hoisting by bucket in the shaft. A pump is to be installed at the lake shore 300 feet distant and will be worked by steam from the present boiler to supply the same. A 24-foot collar has been already set in the shaft and a suitable ladderway and hoisting compartment is now under construction, on the completion of which mining will be resumed and the first level from the present depth in the shaft driven along the course of the vein.

The total force numbers 7. Buildings consist of shaft and engine houses, blacksmith shop, boarding camps, stable and office. Instructions were left to immediately replace the broken water gauge on the boiler and to fence the two old shafts on HW 38.

BIG MASTER MINE.

Locations H P 366, 367, 368, 369, 373, containing about 200 acres, are situated one mile southeast of G ld Rock on the upper end of Upper Manitou lake. The owners and operators are the Interstate Consolidated Mining Co.; capital, $700,000 in one dollar shares; head office, 63 Erie County Bank Building, Buffalo, N.Y. President, Hon. C. W. Stone; vice-president, Wm. Schaler; treasurer, M. Nellany; secretary, M. A. Myers; general manager and engineer, Daniel Simpson.

According to the plans there are on the locations five parallel veins, each of which has been proven by surface crosscuts and test pits and in one case by a shaft. This last is full of water now, but is said to be 50 feet deep and sunk on one of the easterly veins. It is timbered down for 35 feet, 6 by 8 feet in size, and inclines a few degrees east. A few only of the surface pits are at present exposed; but one, 150 feet north of the new shaft buildings shows a vein of white and grey quartz from 18 inches to 2 feet wide, lenticular in character, lying in the folds of a finely schistose dark trap, with a gouge on either side from 1 to 2 feet thick filled with other small quartz stringers. Another pit about 700 feet south-west of this exposes a similar quartz lead, the strike of the vein in both being the same, namely, north 22 degrees east and south 22 degrees west, and the dip a few degrees east. Since September, 1900, a new main working shaft has been sunk on location HP 366; depth, 55 feet; size, 5 by 9 feet inside timbers; dip, vertical; piercing the country rock of schistose green trap highly impregnated with iron pyrites, and just east of the vein above described. The plan for future underground development consists of continuing the shaft to 120 feet depth, then from the 100-foot level to crosscut both ways to all the veins which have been found on the surface. A contract for this work has already been let, the mining to be resumed at once. Sets of stulls are being placed at four-foot intervals from the shaft collar down, to carry the casing and guide for a cage, but at present hoisting will continue by bucket. A Cameron pump suspended in the shaft suffices for drainage.

In December, 1900, mining operations were suspended, all hands turning out to install the machinery in the new shaft buildings. The shaft house includes under one roof the engine and boiler rooms on the east side, and on the north a machine shop, the dimensions of the shaft house proper being 18 by 30 feet in plan and 35 feet high. The other rooms are large and spacious in proportion. The machinery already installed here includes one 40-h.p. return tubular boiler; one single drum 7 by 10-inch double cylinder hoist with 250 feet of ⅝-inch steel rope; and one 5-drill Rand air compressor and receiver. There are on hand besides these two similar boilers, five Rand drills, the machine shop outfit and a cage for the shaft. From a pump house erected over a well 100 feet west of the shaft the supply of boiler and other water is raised by a small Snow duplex pump.

The dry room, 12 by 22 feet in size, built over the boiler room, yet approachable from the shaft house only, is a model of its kind, being fitted with baths, washing outfit and hot and cold water, and completely lined on walls, roof and floor with sheet tin to insure its being absolutely fire-proof from the inside against the danger of a possible conflagration from the miners' candles. In the top of the building and over the side of the shaft a water storage tank was built, 6 by 12 by 5½ feet in size, and used during previous operations. In its present position it is a menace to those working in the shaft, and to avoid the chance of a break instructions were left to remove it to a safe position or discontinue its use. A 10-stamp mill plant is on the way to the mine from Fraser and Chalmers, Chicago, but so far the stamp mill building has only the stone cribwork in place. A saw-mill recently purchased by the company, but not yet set up, will supply lumber for the remaining buildings, the saw-logs for which are now being got out. The buildings consist of shaft-house, pump station, blacksmith shop, store and ice houses, boarding camp, office, stable and magazine. The force numbers 35, the miners not yet engaged. The foreman is John Joy.

GLASS REEF MINE

Locations HW 391 and 594 are situated on the east shore of Lower Manitou Lake, south of Beaverhead Island. The owners and operators are the Glass Reef Gold Mining Company of Lake Manitou, Limited; president, A. P. Buchanan; vice-president, Hon. Hugh John Macdonald; secretary-treasurer, E. H. James; mine superintendent, Geo. W. Glass. The mine had been worked continuously for over a year, and very fine complete hoisting machinery and treating plant erected, but on December 22, 1900, after about two months' mill testing of the rock from the mine workings, everything was closed down and no work has since been done.

Following are the underground measurements: Shaft: depth 200 feet; size, 7 by 14 feet; vertical. First level: depth, 74 feet; south-west drift, 300 feet; crosscuts from face, north-west, 10 feet, south-west, 8 feet; north-east drift, 85 feet; at 10 feet in drift a crosscut tunnel southeast to the hillside, length, 280 feet, the last 40 feet open cut; at 12 feet in drift an upraise, height, 45 feet; from top of this a drift southwest, 6 feet; at 45 feet in drift a crosscut northwest, 280 feet. Second level: depth, 176 feet; southwest drift, 25 feet; at 10 feet in, a crosscut northwest, 12 feet; northeast drift, 25 feet. All drifts and crosscuts are 6 by 7 feet in size. Stopes: First level, southwest at 12 feet; length, 24 feet; height at apex, 35 feet; timbered over with stulls and lagging; this stope continues 35 feet farther, in height 5 feet above level. Width of stopes, 6 feet.

The shaft is divided into three compartments, ladderway, hoistway and spare, the collar extending down 35 feet. Hoisting was done by bucket with cross-head guide bar Drainage was effected by a No. 5 Cameron sinking pump and by pumps from sumps on the first level.

The nature of the deposit was described in a former report, it being a faulted and schistose area in a massive dark green trap dike, the schist carrying lenses of quartz. The shaft was started down on one of these and though it pinched out at about 20 feet depth, sinking continued in the schist, and, as the above measurements show, the dike of trap explored thoroughly both by drifts and crosscuts, but with unsatisfactory results, for throughout all the drifts nothing but scattered lenses and stringers of quartz were found, seldom over a foot and a half wide, short and with no apparent continuity, and in the crosscuts nothing but trap.

The shaft-house, 25 by 30 feet in plan, is fitted inside with chutes leading to the waste dumps and with an ore bin, below which latter is the terminal station for a surface gravity tram leading to the stamp mill 600 feet north on the lake shore. The cars enter beneath the gate of the bin and are there loaded. Southwest of the shafthouse 20 feet stands the enginehouse, in which are installed a horizontal return tubular boiler, a double cylinder hoist with $\frac{5}{8}$-inch steel rope and a 3-drill Rand air compressor. An extension of the building includes a blacksmith and machine shop and the dry room. The tram-car leaving the shafthouse passes on a trestle over a ravine 150 feet wide and thence to the stamp mill, the line being composed of three steel rails laid on an easy incline.

The stamp mill plant was furnished by Fraser and Chalmers and consists of ten 1,000-lb. stamps, Challenge ore feeders, amalgamation plates, a Brown's 4-compartment hydrometric classifier, 3 Frue vanners, one with corrugated belt, and the crusher, all of which machinery, as well as the dynamo, is operated by an 85-h.p. 12 by 12-inch steam engine. In another room beyond is a return tubular boiler and several pumps. The housing, including engine and boiler rooms, was built large enough to accommodate a 20-stamp mill. There is also a sawmill lying a short distance to the northeast along the shore, from which lumber was obtained for the buildings, dressed rustic forming the outside covering of all of them. The remaining houses are office and assay office, boarding camps, four private dwellings, warehouse and stables.

During the time of the mill run the total force numbered 84, of which 33 were miners. The property is now in charge of Mr. Ross and three others, and the former informed me that

it was the company's intention, as soon as more money could be raised, to continue sinking and further explorations underground in hopes of striking ore.

SAIREY GAMP MINE.

Location G 149, of 140 acres, is situated on the north side of Sairey Gamp lake which lies half a mile west of the south arm of Lower Manitou lake. The owners and operators are the Rainy Lake Mining and Power Company; head office, Wisconsin Building, West Superior, Wis. President and general manager, O. A. Watzke; vice-president and treasurer, I. N. Snider; secretary, C. N. O'Hare; mining engineer, E. F. Russell.

Mining operations have been conducted here off and on for a year. There is a vertical shaft, depth, 75 feet; size, 5 by 8 feet. First level: depth 70 feet; crosscut north 22 degrees west, length 24 feet. The deposit consists of a large body of clear quartz apparently lying in the folds of the formation, for the strike of both is the same, namely, northeast and southwest, and also the dip, 80 degrees northwest. The shaft was sunk in solid quartz at the top but in only a foot of it towards the bottom owing to the dip of the vein. The country rock is a finely schistose green trap which near the vein is altered to a chloritic schist. The 24-foot crosscut at the bottom of the shaft was driven through to its face in vein matter composed of quartz lenses and stringers interbanded with chloritic quartzose schist, the quartz at one place being 5 feet in solid width. When the crosscut strikes the hanging wall it is the intention to drift along this to a point under the highest exposure of the vein and then upraise to the surface. The shaft collar, 10 feet deep, supports a string of ladders hanging vertically to the bottom in bad condition and without platforms or casing; and instructions were left to comply with the Mines Act regarding the same. The hoist house stands 30 feet from the shaft and head frame, the machinery consisting of one 25-h.p. locomotive boiler and a 5 by 8-inch oscillating cylinder hoist engine with half inch steel rope. Buildings consist of hoist house and two boarding camps. The total force is 12, of whom 6 are miners. Superintendent, Paul Gasse.

GOLD STANDARD MINE.

The Gold Standard location consists of the south 70 acres of G 340; and adjoins to the west the Sairey Gamp mine. The owners and operators are the Gold Standard Mining Company; head office, Morris, South Dakota. President, Judge C. L. Brown; vice-president, H. L. Smith; secretary, R. J. Hall; treasurer, W. F. Cooley; general manager, Anton Watzke.

Location G 340 was bought by a party who subsequently had it surveyed into three separate claims, each reported to carry a quartz vein. The above company was then formed and the south claim of 70 acres transferred to it, the vein on it to be worked first; if this does not prove valuable, the second claim will be turned over, and so on to the third and last claim. Last fall a body of quartz on the claim on which work has just recommenced was crosscut on the surface, exposing 8 feet of quartz between walls of finely schistose green trap rock. A force of 7 miners are employed, the work being superintended by Paul Gasse, who is also foreman at the adjoining Sairey Gamp mine, where both forces are living.

New Klondike Region.

A seven mile spur of the Canadian Pacific Railway has been constructed from Dyment part of the way into this district, and though intended primarily for the Sakoose mine, will be available for other mines in the vicinity. The purchase and rapid conversion of the Sakoose property into a producing mine within the last year has already established a name for the region, even though at present this mine and another location are the only ones being developed. My inspection of these properties was made in the first few days of January, 1901.

SAKOOSE MINE.

On locations H W 416, 468, 475, and N T 22, six and a quarter miles south of Dyment station of the C. P. R. is situated the Sakoose Mine, formerly called the Golden Whale. It was owned and operated by Messrs. Munro and Watson until the spring of 1900, when the group of locations was sold to the Ottawa Gold Milling and Mining Company, Limited, on the report of this company's engineer, H. A. Guess, M.E. The officers of the company are : president, Hon. Geo. E. Foster ; vice-president; John Mather ; secretary-treasurer, James Gibson. Head office, 72 Albert street, Ottawa, Ont. This company also owns the Keewatin Reduction Works at Keewatin, Ont., and in order to ship the Sakoose ore there for treatment a spur line of standard gauge railroad seven miles in length has been constructed from the C. P. railway tracks at Dyment to the mine

The mining done by the former owners was noted in the report of last year, and included the sinking of three shafts, Nos. 1, 2, and 3. Operations were resumed under the new management in June, 1900, with the following results to date : No. 1 shaft, at the southwest end of the mine, enlarged to 6 by 14 feet size ; depth, 165 feet ; inclined about 75 degrees southeast. First level, depth 75 feet ; northeast drift, 83 feet ; at 50 feet in, a branch drift east 47 feet ; west drift, 95 feet. No. 2 shaft, 200 feet northeast of No. 1, depth, 108 feet ; size, 7 by 9 feet ; vertical at top gradually inclining to 50 degrees southeast at bottom. First level, depth 35 feet ; southwest drift, 45 feet ; stoped out from end to end and up to surface, stulls and lagging in place ; now abandoned. Second level, depth 105 feet ; west drift, 34 feet : east drift gradually turns southeast to 45 feet in, then sharply to southwest, 55 feet farther. No. 3 shaft, at northwest end of mine, abandoned at present. Stoping : No. 1 shaft, first level, northeast at 8 feet ; length, 26 feet ; height, 13 feet ; width, 4½ feet ; the first set of stulls and lagging in place above the level. First level, west at 50 feet : length, 30 feet ; height, 5 feet ; width, about 4 feet.

No. 1 or Main shaft is timbered to the first level and divided into three compartments, two hoistways, 4 by 4½ feet size, and ladderway, 3½ by 4½ feet size. The timbering does not extend below the first level, the ladders hanging in a continuous string to the bottom. A sheet steel chute lying across the floor of the level at the shaft overhangs the bucket and into this the tram cars are dumped. Instructions were left to build a safe passageway around or over this chute. In No. 2 shaft the manway is not partitioned off from the hoistway and the ladders are suspended one from another all the way down. Powder, caps and fuse were found lying side by side by the tramroad on working levels ; instructions were left to observe the requirements of the Mines Act for the storage of powder underground. Hoisting is done in both shafts by buckets on skids, and in the main shaft there are two buckets, one working from the first level and the other from the shaft bottom.

The quartz vein has been followed down by both the above shafts. The ore consists of a dark quartz containing variable quantities of zincblende, chalcopyrite, pyrites and galena, lying in a fissure tight against walls of a brownish grey disturbed quartzose schist, which presents a blocky appearance due to the numerous jointage planes. A dike of quartz porphyry runs in and out through this broken up area of country rock and for long stretches lies against the quartz vein. The vein, though maintaining on the whole a uniform strike of northeast and southwest, breaks away occasionally, running along flat for a short distance and then turning sharply down once more, or again as abruptly changing its strike to a direction at right angles, in one case running for 30 feet before resuming the old course. It is these sudden changes in the plane of the vein which cause the erratic course of some of the underground drifts. On account of its wavy nature the quartz lead ranges in width from a few inches up to five or more feet, so that in stoping a large percentage of the wall rock has often to be broken down also,

but this contains considerable iron pyrites in which it is said sufficient gold values are found to make it pay to ship the mixture without a careful sorting, and this is what is done.

The shaft house, 18 by 20 feet in plan, stands against the west side of the main shaft, the skidways continuing up from the mouth to the top of the building, where an automatic device dumps the buckets, if of waste, into a tramcar, and if of ore, on a flat grizzly to receive a rough sorting out of gangue and then be dropped into the bin below. From here it is trammed 150 feet along a trestle to the railway cars. The engine for the main shaft is an $8\frac{1}{4}$ by 10-inch double cylinder; a double friction drum and brake standard Lidgerwood hoist using $\frac{3}{4}$-inch steel rope is installed 125 feet to the southeast in a substantial frame building. For No. 2 Shaft there is a small double oscillating cylinder hoist using $\frac{1}{2}$-inch steel rope, installed 20 feet to the east. Both these hoists, as well as all the pumps and drills, are operated by compressed air, brought through a 5-inch pipe from the new compressor plant 3,500 feet to the southwest of the shaft. The old stamp mill building was converted into the compressor house, the old plant removed and the new machinery put in its place, consisting of two horizontal return tubular 80-h.p. boilers, the high pressure half of a 14-drill Ingersoll air compressor and a receiver. The water supply is obtained from a small creek crossing the locations at this point.

Ore has been shipped from the mine to the Reduction Works at Keewatin for the last six months, but as yet not in sufficient quantities to supply regularly more than one of the two 10-stamp batteries. Lumber brought in by rail from Rat Portage was used in the erection of the new buildings, which include beside those mentioned a boarding house, manager's and several employees' dwellings, blacksmith and machine shop, dry and store rooms and stable. Following are additional instructions left in the Inspector's book: Case off the ladderway and build platforms in it below the first level, main shaft, and also to the bottom in No. 2 shaft; erect a pentice above workmen sinking in main shaft. The total working force numbers 46, of whom 27 are miners; W. J. Gordon, foreman; manager, H. A. Guess, M.E.

MAW GOLD PROPERTY.

This property consists of locations H W 455, 476, 477, 478, 479, situated to the east of and adjoining the Sakoose mine group. The present operators are S. O. Greening of Hamilton, Ont., and J. Maw. The mine manager is A. F. Botsford; the force consists of 5 miners.

The formation as exposed in the one shaft is similar to that of the Sakoose mine. The shaft is sunk close to the boundary line of location H W 477 on a narrow vein striking northwest and southeast with dip of 80 degrees at top, soon flattening out to the southwest and disappearing in the wall. The shaft, 7 by 9 feet in size, depth 38 feet, is to be continued to a depth of 60 feet at 80 degrees incline instead of following the vein, and from the bottom crosscuts will be driven if necessary to find the quartz. Though considerable surface stripping and test pitting has been done during the last year none of it could be examined on account of the snow. The only buildings are the sleeping camp and blacksmith shop, the men boarding at the adjoining mine.

Sturgeon Lake Region.

Sturgeon lake lies about 40 miles due northeast of Ignace on the C. P. R., but is reached by a longer route which takes advantage of a chain of lakes in both summer and winter. In the fall and winter of 1899 the first mining in this region was undertaken by a company from the United States which has worked continuously since then, exploring its properties by several shafts and a tunnel. Numerous claims were located during 1900, and several large transfers to mining corporations have been made. The Ontario Government last fall constructed a waggon road from Ignace to the waterways and on the necessary portages leading to this region,

and over this machinery is now being transported. Indications point to considerable activity this coming year both in further prospecting and in actual development of the quartz bodies. No trip of inspection was made to this region.

STURGEON LAKE COMPANY'S LOCATIONS.

The following information regarding the above locations was obtained from the manager, Mr. H. D. Symmes:—The group of locations B G 155, 156, 157, 158, 159 were purchased in the fall of 1900 by the company, and these together with ten more claims of 40 acres each since acquired make a total of 568 acres covering a distance of 4¼ miles along the main Sturgeon lake contact between grey granite and trap. The owners and operators are the Sturgeon Lake Mining Company, head office, St. Catharines, Ont. President, Geo. Dawson; secretary, J. E. Varley; treasurer, H. J. Taylor. The two veins now being worked have been prospected by stripping and test pits and show up of great length, the one 60 feet in width and the other, 10 feet, both carrying small quantities of the sulphides of iron, copper and lead, and good values in gold. A 10 stamp mill is now in the course of erection on the property. Machine drills have been ordered and it is expected that the plant will be in operation early in the spring.

Upper Seine Region.

Unfortunately for the reputation of this district, which I visited during the last week of December, 1900, several of the largest and best known properties are at present closed down. However, a number of new ones have made a start, and development of them is progressing on a considerable scale. At Island Falls the mines have also been idle for a while, but Mr. James Hammond, the owner of location A L 282, reports that this mine is to be re-opened this spring and mining resumed.

HAMMOND REEF MINE.

The installation of the new plant at this mine was completed by the end of June, 1900, and after some experimental testing regular operations beg about August 1 and continued until October 6, when the accident occured which closed down the stamp mill. During a storm the wires were struck by lightning which jumped all the arrestors and burned out several coils in the field of the mill motor, stopping it instantly. It will be necessary to ship the injured part for repairs, but so far this has not been done. Following the accident mining operations were also suspended, and though the generator at the power house ran on for a time to light the camps, practically no work has been done since. Mr. Wm. Tedford, the manager, informed me that at the time mining operations were showing up too low a grade of ore for profitable treatment, and that this together with uncertainty as to the value of the rest of the property due to insufficient development work made it advisable to close down the whole mine until a new and different course of operations should be adopted

The plant is left in good condition, three men besides the manager being still resident and in charge. The quarry has been worked out to 50 by 150 feet on the surface and to 35 feet maximum depth, and near the west end a vertical shaft has been sunk 60 feet deeper. Two surface crosscuts about three feet deep were made in the deposit, one 50 feet long just west of the quarry, and the other 100 feet in length at 1,000 feet west; and at 300 feet west a tunnel 55 feet long was driven south into the bluff crosscutting the deposit. This covers the recent mining operations. An engine house stands close to the quarry containing the old machinery, a boiler, double drum hoist, 2 pumps and 3 machine drills, all in use before the close down. Distant 200 feet from the quarry the crusher house was erected, connected with the mine by

a cable derrick overhanging the quarry and with the stamp mill by an aerial tram. The derrick dumps the loaded bucket at the top of the building over a chute leading to an 11 by 16-inch Blake-Marsden crusher, whence the ore drops into bins below to be loaded into the tram line buckets on the ground floor where the terminal station is situated. One 20-h.p. electric motor operates the derrick from the top or second floor, and another 20-h.p. motor in a dust-proof room on the first floor runs both crusher and tram, the latter thrown in from below by friction clutch. The tram, of the Bleichert patent, extends from here 800 feet to the top of the stamp mill, rising 70 feet in this distance and supported on one intermediate standard; and at this upper terminal the trolley track is so placed that the buckets distribute the ore to all parts of the mill bins.

The old mill building was extended to accommodate the 30 new stamps and additional vanners, leaving however the old 10-stamp mill machinery intact to handle at any future date separate lots of ore for experimental tests. The 40 stamps are installed in four 10-stamp batteries fed from 8 Challenge ore feeders, the new stamps weighing 1,200 lbs. each, while the old ones weighed only 800 lbs. With all of them inside and outside amalgamation is practised. No classifiers being used the pulp passes from the plates directly to the Frue vanners of which there are 8 with 12-foot smooth surface belts. Tailings flow into the flat below and the concentrates, the bulk of which is small amounting only to about 0.75 per cent. of the ore, are hauled to a storage bin. The water supply is pumped from the lake about 2,000 feet distant into two tanks in the upper part of the building. One 100-h.p. electric motor installed in an extension of the vanner room in a dust-proof compartment is connected with the battery counter-shaft by belting which first passes over an intermediate jack shaft pulley from which the vanners are run; no other power than this is used in the stamp mill. Radiator coils are ranged round the ground floor and supplied with steam from a boiler situated behind the motor room, and in order that all the heat may be retained the mill is ceiled over below the terminal tram station in the top.

A new pumping station has been erected on the shore of Sawbill lake, the plant consisting of a Snow duplex pump, a 30-h. p. upright boiler, and a water tank 5 feet in diameter and 18 feet deep sunk into the ground into which water runs from 300 feet out in the lake through a 1-foot wooden conduit buried deep, thus securing a means of supply that is independent of the season.

About two miles from the camp and on the farther shore of Sawbill lake the electric power machinery is installed in one building 24 by 24 feet in plan and provided with living apartments above for the staff. The plant consists of one 325-h. p. compound Crocker turbine, the two 20-inch wheels on horizontal shafting connected by belting to a 3-phase alternating current generator of 225-h. p., an exciter, a Replogle governor for the water wheel, and $2\frac{1}{4}$ miles of wire strung from here to the mine, the lake being crossed on cribwork and islands where possible. The flume, a wooden pipe built up of 3 by 8-inch plank, 5 feet inside diameter, extends from the power house up and back 700 feet to the lower dam. On November 24, while in operation, a plank gave way near the upper end of the flume where the retaining iron bands were not sufficiently close together and this caused the collapse of about 50 feet, and also the consequent close-down of the power house. The break is still unrepaired.

The construction and situation of the three dams was described in a former report, but it may be well to summarize here the system of storage by which the water supply for power is obtained. The main storage basin is Clearwater lake, a body of water about 14 miles long by 2 miles wide, draining a limited area in its vicinity. The upper dam raised this lake 10 feet and then, overflowing, the water runs to a smaller basin some distance away dropping 50 feet and is here retained by two dams. From one of these the water is conducted under pressure in the flume to the power house, attaining a head of 50 feet down to the tailrace level into Sawbill lake.

The assay office situated south of the stamp mill contains a complete outfit including retorting and smelting appliances. Lumber in any quantity can be obtained at no great expense from a sawmill on Eye lake a few miles distant.

GOLDEN WINNER MINE.

This property consists of four 80-acre locations situated on a small lake 4 miles northeast of Sawbill lake and a mile and a half east of the Bonheur-Sawbill road. The owners are The Duluth Mining Company ; offices, Duluth, Minn., president, N. J. Upham. Operations were discontinued in October, 1900, after about a year and a half's work. A stamp mill has been erected close to the mine, the building being large enough to accommodate a 10-stamp plant, but at present the machinery consists of a 5-stamp Fraser and Chalmers battery, amalgamation plates, one Frue vanner, a Reliance crusher, a locomotive boiler and one steam engine. The water supply was drawn by gravity from a small pond in a swamp 700 feet distant. From the rear of the mill and on a level with the crusher floor a trestle extends back 100 feet to the shaft, along which the ore was trammed into the mill. Close to the shaft and head frame stands the hoist house containing a small vertical boiler, a 4 by 12-inch single cylinder hoist engine using $\frac{5}{8}$-inch steel rope, and a duplex pump.

The deposit as exposed down the shaft is a large body of chloritic schist interbanded with quartz lenses and stringers all more or less highly impregnated with iron pyrites and dipping about 45 degrees south. The underground workings being partially flooded, the following information and measurements were obtained from the late foreman, J. Marshall : Mining started in the spring of 1899, being then confined to surface explorations. Seven test pits were sunk on an 18-inch pay streak on the hanging wall at the surface, and a 150-foot crosscut stripped the deposit from wall to wall. In October of the same year underground development started, progressing steadily till the close-down a year later. The shaft is 62 feet deep, size 8 by 8 feet, timbered with a 20-foot collar and having hoisting and ladderway compartments. First level: depth, 62 feet ; crosscuts, north, 15 feet ; south, 80 feet. At 74 feet south the hanging wall was struck and has been drifted on, east, 42 feet ; west, 38 feet. One overhand stope level removed for the total length ofthis drift, and in west drift a second level, length, 20 feet ; width of stopes, about 4 feet. The south 80-foot crosscut was widened for its length to 10 feet, and this with all other rock mined was put through the mill.

The workings are about one-quarter mile northeast of the lake on which the camps are situated. The buildings consist of stamp mill, hoist house and blacksmith shop at the mine, and office storehouse and boarding camps on the lake. The above operations were conducted under the management of J. Howenstein. A force of three men were given a contract to cut cordwood for future operations and are now engaged in fulfilling it.

SAWBILL MINE.

Nothing has been done at this mine since the close-down in the fall of 1899. No one is paid to look after the property, and as a consequence machinery, buildings and assay office are not in the best of condition.

CLEAR LAKE MINE.

This property comprises locations B J 115, 116 and X 785, 786, 796, in all 187 acres, and is situated on Clear lake, one mile north of Jack lake and 12 miles south of Sawbill. The owners and operators are the Clearwater Gold Mining Company ; head office, Saginaw, Mich. President, W. F. Steevens ; vice-president, P. R. Proctor ; secretary-treasurer and general manager, C. P. Anderson.

Mining has been carried on continuously since November, 1899, confined, however, to location X 785, and the work done is as follows: No. 1 shaft. depth, 144 feet; size, 7 by 9 feet; dip vertical for 60 feet, then gradually inclining to 80 degrees north. First level: depth, 82 feet; southwest drift, 63 feet; at the face, crosscuts, southeast, 12 feet; northwest, 9 feet; north drift, 56 feet; at 20 feet in, crosscuts, east, 6 feet; west, 6 feet. No. 2 or Incline shaft, situated 150 feet east of No. 1 shaft: depth, 185; size, 6 by 9 feet; inclined north, at top 60 degrees but gradually flattening to 32 degrees at bottom. There are no lateral workings. A pit 12 by 12 feet in size was sunk 20 feet deep on a body of quartz 90 feet southwest of No. 1 shaft; and a tunnel driven 20 feet north in the side hill, 60 feet south from No. 1 shaft. Both shafts are timbered with a 15-foot collar. In No. 1, the ladderway is partitioned off only from 12 feet below surface to the first level, and in No. 2, not at all; also in the latter the ladderway extends only about half way down. Instructions were left to complete all these. Buckets on skids are employed for hoisting and draining assisted in No. 1 shaft by a Cameron No. 5 pump installed on the first level. Both shafts carry open head frames.

No. 2 shaft follows down the footwall of a true fissure vein, which is apparently quite separate from that in the No. 1 workings. Between walls of massive gray granite a wavy vein of quartz from a few inches to two feet wide extends from top to bottom of the shaft, but at this depth at the time of my visit a fault had been struck cutting off the vein clean, the fault plane being vertical with northwest and southeast strike.

In the other workings to the west, No. 1 shaft is sunk through a gneissoid zone filled with numerous quartz stringers and in the same gray granite. The north drift at 82 feet depth shows no quartz, but the southwest drift follows along a few stringers in the schist for 40 feet, when the quantity increases a little and at 53 feet the drift breaks abruptly into a mass of quartz and schist 14 feet wide running into this 10 feet farther. The quartz of both veins contains little or no sulphides.

The engine house lies between the two shafts and installed close together in the one room are the two hoists, one, a 5 by 8-inch compound cylinder, with 300 feet of new ⅝-inch steel rope hoisting from No. 2 shaft, the other a 5 by 10-inch compound cylinder, with 300 feet of ⅝-inch steel rope hoisting from No. 1 shaft, and a 35-h.p. locomotive boiler without a water gauge.

The signalling apparatus is primitive, and instructions were left to replace it by two differently toned gongs, also to install a suitable signal rope and to put a water gauge on the boiler. Other instructions left in the Inspectors' book are to fence both shaft mouths; scale walls of No. 1 shaft regularly; shift the present or build another powder magazine according to the requirements of the Mines Act.

The buildings of the camp are engine house, blacksmith shop, boarding houses, office and assay office, stables and store houses. The total force numbers 20, of whom 9 are miners; foreman, J. Gilbert.

JACK LAKE MINE.

Locations A L 325, H P 676, 677, 678, 679 and B J 111, 112, 113, 114, of 40 acres each, totalling 360 acres, are situated on Jack lake, 12 miles south of Sawbill or 46 miles south of Bonheur, C.P.R. and 7½ miles north of Atik-okan river siding, O. R. R. Ry. The owners and operators are The Jack Lake Gold Mining Company, Limited; head office, Saginaw, Mich. President, Ezra Rust; vice-president, G. W. Weadock; secretary-treasurer, M. Pursell. The mine staff consists of manager J. S. Steele; superintendent and assayer, B. Z. Kasson; foreman, R. Andrew.

Work has gone on steadily for over a year with the result that excellent camps have been erected, mining machinery installed and the mine opened up extensively. Operations have been confined to one location, AL 325. Main shaft: depth, 192 feet; size 8 by 12 feet; the first 140 feet vertical and the rest inclined 80 degrees south east. First level: depth, 102 feet; north

east drift, 30 feet ; at 15 feet in a crosscut southeast 16 feet ; southwest drift 32 feet; at 10 feet in a crosscut northwest, 8 feet. Second level, depth 187 feet ; southeast crosscut from shaft, 9 feet. On the vein southwest 350 feet from the main shaft, an 8 by 10 air shaft has been sunk about 20 feet and discontinued.

The ore body is a true fissure vein in gray granite, in which the original faulting has altered an area of about 30 feet wide extending on both sides of the present quartz vein, the effect being to gradually change the massive granite through gneiss to mica schist, which has again been altered in its central portion during the subsequent deposition of the quartz. The shaft in following the vein down exposes one main quartz vein 16 inches to 4 feet wide, and on both sides of this more quartz occurs in various sized lenses and stringers interbanded with light colored chloritic schist, the whole mass in places over 8 feet wide. In the face of the southwest drift at 102 feet depth and at 140 feet depth in shaft, a fault has been encountered which cuts off the vein, the plane dipping 50 degrees to 60 degrees east with north and south strike. The direction of movement was along an incline of about 45 degrees and the horizontal component is found, from a surface exposure of the vein southwest of the shaft, to be 27 feet. The crosscut southeast from the bottom of the shaft is being driven to tap the fault plane and drifts will follow along this for the continuation of the vein beyond.

The hoist house, situated to the southwest of shaft and enclosed shaft house, contains a 40-h.p. locomotive boiler, a 5 by 8-inch double cylinder hoist with 300 feet of ¾-inch steel rope, 3 Rand machine drills formerly used with steam in the workings, and a spare duplex pump. The camp buildings include engine house, shaft house, blacksmith shop, magazine, boarding house, office, storehouse and stables.

Instructions were left in the Inspector's book to complete the casing between manway and hoist compartment in the shaft. The total force numbers 14, of whom 8 are miners.

Under date of February 23, 1901, word was received from Mr. B. Z. Kasson that the continuation of the vein had been found in the first level, while in the second both ends had been struck.

SAPAWE LAKE PROPERTY.

This location lies on the north shore of Sapawe lake, 2 miles from the Atikokan river outlet. J. J. Walsh, the owner, did some prospecting work during the year on the property but this was discontinued until recently, when 3 men started in building camps, on the completion of which it is the intention to resume mining on a larger scale.

The deposit as seen from the present 6-foot pit and its proximity consists of a fissured zone, of chloritic schist, light to dark green in color, striking east and west with vertical dip, filled with quartz bands and lenses irregularly intermixed and containing but very little iron pyrites. Operations will be confined to enlarging this pit to 6 by 8 feet and sinking a vertical shaft therein.

Lake Superior Region.

Several new properties are being worked this winter, but on the whole mining is not very active.

BRULÉ CREEK PYRITES MINE.

The Davis Sulphur Ore Company have acquired 400 acres of mining lands lying on both sides of Brulé creek in the northeast corner of lot B, concession V, Conmee township, one-half mile from Kaministiquia river opposite Kakabeka Station, C.P.R. The officers of the company are : President, H. J. Davis ; secretary, C. B. Stranahan ; head office, 65 Wall St., New York. Mine manager is J. H. Woodside.

A shaft is being sunk on the south side of the creek, the present depth being 10 feet through gravel to the deposit, which covers the bottom of the shaft, and extends under the gravel on

all sides. It is composed of a black aphanitic rock highly impregnated with small amorphous masses of iron pyrites and a little pyrrhotite, the mixture ranging from almost solid pyrites to rock containing but little sulphides, but owing to lack of other exposures the nature and size of the body could not be determined. This deposit is being worked for its sulphur. The force numbers three men, and the only building is the blacksmith shop.

LAKE SHEBANDOWAN GOLD MINE.

The following information regarding this mine is obtained from the manager, Mr. J. W. Boyd: Mining location, X 524, of about 95 acres; is situated on the south shore of Shebandowan lake 3 miles south of Kashaboiwe Portage siding on the new Ontario and Rainy River Railway. Owners and operators; The Golden Hecla Mines Syndicate; head office, Winnipeg, Man. Work has been going on since August, 1900, with an average force of five men, the buildings erected consisting of sleeping and boarding camp, blacksmith shops, powder house and engine house.

The deposit being explored is a wide outcropping, traceable for a long distance, composed of light colored schists interbanded with stringers and lenses of quartz, the whole mass forming a large bluff. By stripping and test pitting the surface has been well prospected, and now a tunnel is being driven into the hill at an angle with its strike to crosscut the body, which at 400 feet in will be under the crest of the bluff, 350 feet above. Some idea may then be formed of the continuity of values both in depth and across its great width. It is a low-grade, free-milling gold proposition which, if at all, will have to be treated on a large scale. Last fall machinery was bought consisting of boiler, a 2-drill Rand air compressor and two machine drills of the Chicago Pneumatic Tool Company type, but it has been held in Port Arthur up to the present waiting until the roads are in better condition for transportation. The buildings, however, are ready for the machinery, and 270 cords of wood are on hand.

WEST END SILVER MINE

Operations have continued steadily since the last inspection a year ago, with the exception that, as during last winter, the concentrator is closed on account of lack of water and as a consequence of this no ore is hoisted but is piled in the old stopes, or if it be shipping ore, along the sides of the levels. Measurements of underground work to date are as follows:

No. 1 shaft: no new work.

No. 2 shaft: no further sinking. First level: east drift, 164 feet; west drift, unchanged. Second level: east drift; from the face, a crosscut north, 10 feet. Third level: east drift, unchanged; west drift, 456 feet. Fourth level: east drift, unchanged; west drift, 367 feet.

Stoping: Between the two shafts and above the first level the stope has been enlarged a little but discontinued as the ground was found unsafe. Below first level floor, 55 feet west of No. 2 shaft: length, 40 feet; depth, 10 feet; width, 6 feet; this was a remaining block overhanging the old stope. At 140 feet west, first level, the north branch of the vein has been met and stoped out, length, 100 feet, towards No. 2 shaft; height, at centre 25 feet, at ends 10 feet; average width, 3 feet. At 120 feet east, first level, underhand: length, 26 feet; average depth, 10 feet; width, 4 feet. Third level, west, underhand: No. 1 stope: extended to length 50 feet. No. 2 stope: extended east 30 feet. Third level, at 120 feet east, underhand: length, 16 feet; depth, 8 feet; width, 4 feet.

Mining operations are at present confined to underhand stoping on the first level, east of No. 2 shaft, and to driving the third level west to connect with No. 1 shaft. The manager, Mr. H. Shear, informed me that the intention is to continue the third level drift west on the vein beyond No. 1 shaft and out to the surface about 1200 feet farther, at which point the exit will

be only a few feet above the bottom. This will drain the mine above and will also explore the vein along the line of best values.

Instructions were left in the Inspector's book, to place a guard rail on the outside of the passage way along the ledge of rock by No. 1 underhand stope, third level. The total force numbers 18, of whom 8 are miners.

TROMBLY AND GRAHAME COPPER PROPERTIES.

The Trombly copper location, ES 111, is situated on the east shore of Black bay, Lake Superior, about 13 miles south of Wolf River Station, C. P. R. The owners are Peter Trombly, Sr., Peter Trombly, Jr., and W. Pritchard ; address, Port Arthur, Ont.

A force of from 5 to 7 men has been employed here since last summer, 1900, two camp buildings erected and the following mining work done to date : A tunnel, a few feet above and back from the water's edge in the rock bluff, length, 28 feet ; size, 6 by 7 feet ; at the face, a vertical winze, depth, 13 feet ; size 6 by 7 feet. The tunnel cuts through a fine grained amygdaloidal trap weathered soft and brown at the top, but down the winze gradually changing into the original solid aphanitic rock of several colors, black, brown and green, and all pretty uniformly impregnated in small amygdaloidal cavities with nodules of calcite or gypsum, except in the upper weathered portions where a green mineral has replaced the original filling. It is in these amygdaloidal cavities that the native copper occurs, not in all of them but scattered throughout. A few seams of calcite and gypsum have been found along jointage planes in the eruptive, enclosing webs of native copper often 2 to 3 inches long, but in most cases the copper is finely granular.

At a point on the bay about three miles southwest along the shore from the Trombly workings is another tunnel, 10 feet long and similarly situated near the shore and in the bluff. This is on the Grahame property, location ES 109. Here the tunnel and also the face of the hill expose a very coarse conglomerate formed of large rounded boulders of the black amygdaloid with a few smaller masses of jasper and other varieties of rock, all cemented together by a light bluish green colored eruption which doubtless flowed in its general course horizontally around and between the rocks, and is itself well filled with small rounded nodules of the various rocks of the conglomerate. Native copper is to be seen in minute grains in some of all these constituent rocks, but principally in the large boulders.

Some of the owners of the Trombly property are also interested in the Grahame location, and in fact a party consisting of these men and several others have located claims adjoining one another for several miles farther down the shore, all abutting on the water front and staked out for copper. Mr. Trombly, sr., states that at several points along the shore in this stretch a red sandstone crops up lying directly beneath the conglomerate, and that it is his intention to continue sinking the winze down until this sandstone is struck.

MOCCASIN MINE.

Location R 645, of 73 acres is situated about four miles northeast of Rossport and between Fox and McLean lakes. The property was located on a deposit of pyrrhotite and iron pyrites in the expectation that it would prove to be a nickel ore. The owner, J. Bowman, of Rossport, Ont., has been prospecting the outcrops in a small way and intermittently for the last two or more years, and now there are several test pits, a trench 10 feet long by 10 feet deep and a crosscut tunnel in 20 feet, started to strike the deposit under the hill, but since discontinued. The trench is along a contact between red granite and fine grained green trap, and in this, lying entirely in the trap side is the deposite of sulphides, solid from 6 to 18 inches, but afterwards becoming intermixed with trap and quartz until in about two feet in all it merges entirely into a trap highly mineralized with pyrites. No satisfactory

examination of the pits or surface outcroppings could be made on account of ice and snow Work was to have been resumed here in a few days from the date of my visit—February 16, 1901—by a force of two men.

Zinc Ores of the North Shore

The Lake Superior zinc district lies about twelve miles north of the C. P. railway tracks and six miles east of Rossport. During the summer of 1900 prospecting for zincblende deposits was carried on actively by several parties working in and about an area of country of which the Zenith mine forms the centre, with the result that several other properties have been staked out, some of which are to be opened up this year. But since last fall the only mine in continuous operation has been the Zenith.

ZENITH MINE.

Mining operations since a year ago have been confined to driving a tunnel into the hill in which the zincblende deposits accur, starting on the level of the small lake at the foot at a point between the old shafts, about 100 feet north of No. 1 and 500 feet south of No. 2, and beneath the old open stope in the brow of the bluff. The length to date is 75 feet, including 18 feet of open cut at the mouth, and in its course of about northeast the tunnel is intended to crosscut to the main veins found on the surface as well as to explore the country rock.

In the open cut a large body of zincblende was struck and stoped up 15 feet to the surface, in places 4 and 5 feet wide, but of very irregular shape and without any visible continuous walls. At 12 feet in the tunnel another band of solid blende a foot wide runs down into the floor, and at 30 feet beyond this is a third body, 15 inches wide at first but pinching out in 10 feet at the face. Besides these three main strikes many other intermediate stringers and veins from a fraction to 10 inches wide were passed, all having approximately the same strike of north and south and dip of about 25 degrees east into the hill which bearings coincide with those of the outcropping on the large vein on the surface above. The country rock as seen in the tunnel has been disturbed and broken up along two directions, giving it a blocky appearance, the main movement having been sufficient to produce schistose areas in widths from streaks up to several feet, striking north and south with dip 25 degrees east, which directions are the same as those of the ore bodies. In fact it is in this schist, altered in places from the coarse green trap rock to a soft gouge, that most of the veins have been found.

Grains of zincblende occur imbedded in the massive trap having no connection with the main deposits ; frequently also masses of the sulphides pyrites, pyrrhotite and chalcopyrite, are exposed in the seams, both separate from and contiguous to the blende. The massive zincblende in the tunnel workings contains small grains of pyrites and pyrrhotite disseminated uniformly throughout it, forming but a small percentage of the whole, yet in considerably greater quantity than is found in the very coarse blende at the old surface stope.

As soon as warm weather sets in underhand stoping is to be resumed in the 3-foot vein in the old open cut above, from which in 1899 about 400 tons were taken and shipped. The boiler now on hand is to be installed and running inside of two months to supply steam for the 3 machine drills. The working force numbers 10, of whom only 3 are at present mining, the rest cutting cordwood for the boiler. The managing director for the company is J. McLaughlin, and the mine foreman, C. H. Jones.

I inspected this property February 14, 1901.

Iron Mines of Northwestern Ontario.

The iron industry in this region is receiving considerable impulse, due to the interest being manifested in it by outside capitalists who have recently bonded several properties with the intention of exploring them further. The new Ontario and Rainy River Railway has no doubt aided largely in bringing this about, as it is making accessible the whole iron range of the Atik-okan district. The present showing at the Atik-okan gives ample warrant for a thorough exploration of the magnetite deposits there.

In February of this year a purchase was made for a New York company of locations on bodies of magnetite on Current river, about seven miles northeast of Port Arthur. Farther east on the Pic river magnetic iron ore, found some years ago, will be explored this year on a large scale. Besides these many other new finds have been made within the last year. On the Mattawin range, west of Port Arthur, the iron deposits are being explored by the Government diamond drill.

M'KELLAR'S MINE.

Locations E 10, 11 and 12 are situated two miles east of Sapawe lake, on the north side of the Atik-okan river. The iron deposit is of the magnetic variety, and bodies of it outcrop on the locations along a bluff three-quarters of a mile in length, averaging about 300 feet in width, and rising to a height of 50 to 100 feet out of the surrounding swampy land. This bluff and its vicinity are typical of a narrow stretch of country composed of Keewatin altered traps and green schists, extending east and west along the course of the Atik-okan river and Sapawe lake, all these abruptly outstanding hills having their longitudinal axes lying east and west parallel to the general east-and-west strike of the formation.

In the fall of 1899 mining operations were begun and continued steadily till June, 1900, during which time considerable surface stripping and crosscutting has been done at points from one end to the other of the hill, and a tunnel driven through it near its centre, crosscutting from side to side. Owing to the season of the year examination had necessarily to be confined to the tunnel alone, which is 287 feet in length, 6 by 7 feet in section, running north and south, and timbered for 25 feet at both ends where the ground is loose.

Starting at the north entrance and working south, the tunnel passes for 75 feet through a finely schistose light green trap, which lies with a well defined wall against a massive body composed of a mixture of small lenticular stringers of magnetite and a dark green trap rock, all highly impregnated with sulphides of iron. Proceeding, the magnetite gradually increases in quantity, the sulphides and trap decreasing, until at 100 feet in the deposit is solid magnetite extending from a width of 25 feet, where it abruptly ends against a body of coarse green trap. This forms an interruption in the continuity of the deposit for 50 feet, after which for a distance of 75 feet are passed alternating bands of magnetite and coarse trap, each varying in width from about 5 to 10 feet, and now within 35 feet of the south outlet of the tunnel the rock changes to an irregular conglomeration of trap, magnetite, pyrites, pyrrhotite, chalcopyrite and calcite. The coarse trap carries throughout considerable of the above sulphides and occasionally grains and small masses of magnetite, while the so-called solid magnetite bodies, especially the narrower bands in the south part of the tunnel, contain occasional impregnations of trap in thin sheets and films, and also minute grains of iron pyrites fairly uniformly disseminated, yet comprising but a very small percentage of the whole. At the north end the magnetite is very fine-grained, changing towards the centre and south end to coarse. These veins of magnetite strike east and west, lying in the folds of the formation, with vertical dip.

The history of this mine to date was obtained subsequently in February from Mr. A. M. Wiley, Port Arthur, and may be summarized as follows : the original locators, Messrs. Graham and McKellar, of Port Arthur, gave an option to Hunter Bros., of Duluth, who then proceeded

to prospect the deposits to the extent of the above described operations. On the completion of these, the still extant bond was turned over to the American Wire and Steel Co. for a limited period, during which they are to continue explorations. Their first move has been to instal two diamond drill machines on the locations, and these have been in operation since the first of the year under the management of Mr. E. F. Bradt, M.E. The contract for the work is let to Messrs. Cole & Macdonald, the intention being to thoroughly prospect the iron bodies. The camp buildings are situated close to the workings. The Ontario and Rainy River Railway passes about a mile or less to the south.

WILEY BROS'. IRON PROPERTIES.

The following information was obtained from Mr. A. M. Wiley at Port Arthur: The iron locations owned by Messrs. Wiley Bros. lie along the Atik-okan river, between Sapawe and Steep Rock lakes, and adjoining the McKellar group to the west. The deposits of iron outcropping are of magnetite and similar to the McKellar bodies, as far as known. A diamond drill is to be installed on the locations as soon as possible in this spring to explore the veins. The O. and R. R. Ry. passes along the Atik-okan River, skirting the iron range for its whole length, thus affording exceptional shipping advantages if required in future operations.

PIC RIVER LOCATIONS.

Locations X 800 to 809, totalling 1400 acres are situated on the Pic river four miles north of Peninsula harbor, Lake Superior. The owners are Messrs. Wiley Bros., Port Arthur and from one of them, Mr. A. M. Wiley, the following information regarding their property was obtained: The iron occurs as magnetite. During the fall of 1900 the depcsits were uncovered at points from one end to the other of the location by means of stripping and other surface prospecting. The plans for future explorations, to be put into effect this spring, consist of diamond drilling and of crosscutting the bluff on X 800 by a tunnel extending from side to side of the hill, 250 feet in length.

Canadian Goldfields, Deloro: General View of Mine and Works.

Canadian Goldfields, Deloro: Partial View of Works.

MINES OF EASTERN ONTARIO.

BY C DE KALB, INSPECTOR.

The condition of the mining industry in the Eastern District of Ontario is in many respects more satisfactory than ever before There has been a still more conspicuous reaction from the tendency so common in previous years to organize companies and sell stock based upon undeveloped mines. A perusal of the following report will show that a very large number of promising properties are undergoing extensive development by syndicates or close corporations offering no shares in the public market. By some of these large sums of money have been expended in opening up deposits, in advance of any effort to start production. In nearly every instance the result has been to put in sight important quantities of ore which assays demonstrate can be worked at a profit. This is all in the direction of permanent and successful mining, the good effects of which will be seen later on. There is also a notable increase in the employment of skilled management, many highly trained mining engineers and experienced foremen for mines and works having been brought into the Province within the year, and the local labor is receiving in consequence a better training. A larger number of men than heretofore have adopted mining as a regular vocation, many of whom are improving themselves by taking courses of instruction in correspondence schools. The effect of this is to create a most desirable *esprit de corps,* and at this rate Ontario will soon possess a large body of skilled miners, which will be of incalculable benefit to the mining industry. The absence of any legally enforced qualification for mine foremen is still a drawback, and there seems to be no question that such a requirement would act as an additional stimulant to higher efficiency on the part of the workmen, to their own good and to that of the mine owners.

The copper industry is growing rapidly and promises to assume large proportions. The development of the veins occurring west of the Sudbury district at Massey and in the vicinity of Bruce Mines, is most gratifying. At all of these places the ore in sight has warranted steps for the construction of large mills and reduction works. The future of the Parry Sound copper district is as yet somewhat uncertain, but active development is going forward, and the results are by no means discouraging.

Iron mining is becoming a large factor in the mineral industry of the Province, due chiefly to the extensive operations undertaken by the Lake Superior Power Company at Michipicoton Harbor, but the mines in the extreme eastern portion of the Province are also promising good returns in the near future. Extensive shipments have been made from some of these properties during the year, and in several cases development work has revealed large bodies of high grade ore.

The gold mines in the vicinity of Marmora are on a sound basis, and increased plant at these mines, now being installed, will soon lead to a substantial enlargment of the output of bullion. The production of arsenic as a by-product from the gold ores at Deloro has added a new article to the mineral output of Ontario, and the steady manufacture of this material is assured. Only two gold mines of the Eastern district which have figured prominently before the public have closed down, and one of these will be re-opened in 1901 under a new management.

There has been a veritable boom in mica mining in Frontenac and Lanark counties, and a large output has resulted. A careful study of these deposits by the geological corps of the Bureau of Mines might yield information which would prove valuable as an aid in prospecting for this mineral and help to establish the industry on a more permanent basis. The uncertainties

attending development work in the mica mines renders the owners averse to continuing exploration where mining temporarily ceases to be profitable. A number of these mines in which work had been discontinued have been reopened with success, but on the other hand many which have produced largely at one time have been abandoned. Reasonably safe criteria upon which to base further development would be a great boon to the industry, and such knowledge can only come by detailed study on the part of trained geologists.

The peat industry is apparently about to become of great importance. The difficulties attending the cheap manufacture of briquettes have been overcome through the courageous and intelligent efforts of the Trent Valley Peat Fuel Company, and it would seem possible to derive a cheap domestic and steam fuel from the numerous peat bogs in the Province. The Peat Fuel Syndicate of Toronto has also been investigating the preparation and uses of peat in foreign countries, and has been conducting experiments which will tend to develop fully the commercial possibilities of the industry. The utilization of peat as a source of fuel and illuminating gas is being tested, and bids fair to prove successful. A special investigation is being made by the Bureau of Mines into the value of peat for fuel and gas, which will shed much light on this question.

Gold Mines.

The working gold mines of the Eastern District are at the present time confined to the vicinity of Madoc and Marmora. The work here has passed the experimental stage and gives every indication of permanent operations. Development has been carried on systematically, putting large ore reserves in sight ; and the problem of extraction has been thoroughly solved in each case.

THE BELMONT MINE.

This property has been operated under option granted to the Cordova Exploration Company Limited, of Newcastle-upon-Tyne, from Mr. A. W. Carscallen of Marmora, for several years. During this period development work has been actively in progress under the skilful superintendence of Mr. D. G. Kerr. At the same time a 10-stamp mill has been working upon ores taken from various mines on the property, the object being chiefly to test the value of the ore by mill-runs. The stoping consequently has not been extensive in any one part of the deposit. In September 1899 the property was purchased from Mr. Carscallen, and production upon a larger scale will soon commence. All the improvements now in progress are of a permanent character, but extensive development of the deposit is still being prosecuted, which may lead to a further enlargement of the milling plant in the near future. The property acquired consists of 300 acres owned in fee simple in Belmont township, Peterborough county ; mineral rights in 125 acres in Marmora township, Hastings county ; mineral rights under the county roads, acquired from the township councils ; and 160 acres of land including a water power on Deer river, at the outlet of Deer lake, 2 miles west of the mine.

Development work has been carried on in ten shafts, of which Nos. 1, 2, 3, 6, 7 and 10 are in actual operation. Shaft No. 1 has attained a depth of 310 feet, being an increase within the year of 175 feet Hoisting is done by a skip, using telescope rails at the lower end of the skip-way to admit of hoisting rock from the bottom while sinking is in progress. Shaft No. 2 is 165 feet deep, being an increase of 130 feet. This shaft is connected by levels with No. 3 which is the main shaft for this mine, No. 2 being practically an air shaft, although ore and rock are at times hoisted through it. Shaft No. 3 had reached a depth of 185 feet when sinking was discontinued. A new pump is now being installed to permit of going to deeper levels. Shaft No. 6 has been sunk since the inspections of 1899, and is located 750 feet northeast from shaft No. 1. It has been carried to a depth of 85 feet, with a cross-section of 12 by 8 feet, inclining 75 degrees towards the southwest. It is divided into two compartments for a hoist-way and man-way. The hoisting works consist of a head frame 12 by 14 feet at the base, and 20 feet high

to the center of the sheave. Shaft No. 7 is also new. This is located 425 feet north of shaft No. 1. It is vertical, with a depth of 80 feet, and a cross-section of 16 by 9 feet. The hoisting works are 17 by 35 feet at the base, and 35 feet high, and are equipped with a 30-h. p. double drum hoist actuated by compressed air taken from the central air compressor plant. Shaft No. 10 is likewise part of the recent development of the property. It is 560 feet east of shaft No 5, the latter being 1500 feet southeast of shaft No. 1. The shaft inclines 75 degrees to the south, and has been sunk to a depth of 35 feet, maintaining a cross-section of 14 feet by 10 feet. No permanent hoisting works have yet been erected over these shafts.

In shaft No. 1 there has been no change in the 75 foot and 120-foot levels. A new level has been driven at a depth of 200 feet from the surface, extending 50 feet east and 50 feet west from the shaft. A level has also been driven at 300 feet distance from the top, 50 feet east and 30 feet west. A sump has been excavated near the shaft on both these levels, and on the 200 foot level a Northey pump having a capacity of 250 gallons per minute has been installed, while a new pump of 150 gallons capacity is being set up on the 300-foot level. The motive power for these pumps is compressed air at 85 lbs. pressure.

In shaft No 2 a level has been run at 50 feet from the surface, 260 feet northwest and 110 feet southeast to shaft No. 3 ; and at a depth of 90 feet is a level extending 350 feet northwest and 110 feet southeast to shaft No. 3. In the east drift is a new stope, 100 feet long, 10 feet high and 6 feet wide.

In shaft No. 3, at a depth of 25 feet is an incline connecting with the 50-foot drift southeast from shaft No. 2. At a depth of 95 feet in this shaft is the connection with the 90 foot drift southeast from No. 2 shaft, and at 185 feet is a drift northwest 250 feet in which a raise has been started to connect with the bottom of shaft No. 2.

A level has also been started in shaft No. 7, extending 20 feet northwest and 65 feet southeast.

As the levels from these several shafts are extended they will connect with each other, linking the shafts into one connected mine. A trestle for a 24-inch gauge tramway track is being continued from shaft No. 1, which will extend to shafts Nos.7,6,2,3,5 and 10, in the order named, thus making a large arc.

A new shaft-house has been erected over No. 3 shaft, with a head frame 18 by 35 feet at the base, and 30 feet high to the sheaves block. The skip in this hoist is operated by a 30-h. p. compressed air hoist.

The stamp mill is being quite thoroughly overhauled, and 10 additional stamps are being installed, as well as a cyanide plant for concentrates.

The requirements made for additional safety are being suitably attended to. The official signal code is being used at all shafts. It was advised that the powder man be required, among his other duties, to include that of preparing all primers in and about the mines. The company has been peculiarly unfortunate in losing four men by dynamite explosions during the year, two of these being the result of negligence on the part of the miners, and two the result of a premature discharge of explosive while loading a hole, the cause of the explosion being undetermined.

THE DELORO MINE.

The extensive development work carried on upon the property of the Canadian Goldfields, Limited, during the year 1899 has apparently assured permanent work at Deloro, and in consequence important additions to the plant and equipment are being made. The stamp mill is being enlarged to double its former capacity and Mr. P. Kirkegaard, the manager, has developed an improvement in his method of treatment which will enable him to mill upwards of 100 tons of ore per diem. The plant when complete will comprise rock breakers, jigs, 20 stamps of 850 lbs. each, Wilfley tables, Bartlett concentrators, and Frue vanners. The cyanide plant is also being

enlarged by the addition of an extra vat. The mill is a model of scientific arrangement, and includes some new features of great merit, permitting of the elimination of barren gangue early in the process, by which means large capacity is secured at very low cost. The arsenic works constitute a prominent part of the plant, and are turning out a purer grade of white arsenic than any of the foreign competitors, with the result that the product is in large demand at the highest market prices. The arsenic is sold chiefly in New York, though a portion of the output is taken in Canada. At the present time the arsenic plant is undergoing complete reconstruction, for the purpose of securing a larger yield at reduced cost per ton. The difficulties formerly experienced at Deloro from the loss of arsenic, and the consequent imperilling of live stock in the vicinity, have been entirely overcome by modifications in the construction of the condensing chambers, coupled with the introduction of mechanical draft. No cases of arsenic poisoning have occurred, great care being observed to preclude accidents of this sort. Separate rooms are provided for the clean clothing and the working clothes of the employees, and ample facilities for bathing are connected with the dressing rooms. The men are required to bathe at the end of each shift, no deviation from this rule being permitted. Antidotes are freshly prepared at frequent intervals, and are kept accessible in two places in the works, and certain men in each shift are instructed in their proper use.

The company is also making provision for the entertainment of the men, and for the education of their children. To this end a lecture hall and library, and a school are in process of erection near the general office building. Books and periodicals will be provided free of cost for the use of employees of the mine.

The surface plant is being further increased by the installation of a new air compressor to provide air for a Harris air lift which is to raise all the water from that portion of the property reached by the Gatling and Tuttle shafts. An electric lighting plant is also being provided, the engine and dynamo being placed in the present engine house near the stamp mill.

In place of the old stone dynamite magazine, which was too close to the mines and works, a new one constructed entirely of wood, well ventilated, and with sand filling in the hollow wall spaces, has been provided, standing detached 600 feet from the arsenic works, and 1,000 feet south of the mill. A new dwelling has also been erected for the mine foreman.

The progress in underground work during the year is as follows: Gatling level No. 3 south, increased 169 feet 3 inches to a total of 426 feet 3 inches; Gatling level No. 4, increased 360 feet to a total of 393 feet 6 inches; Tuttle crosscut level, south, increased 41 feet to 135 feet; Gatling crosscut level, south, increased 8 feet to 120 feet 6 inches; 3rd level stope beginning 200 feet south from Gatling shaft, working underhand, the full height of the block between the second and third levels; a raise is also being driven up from the fourth level, 250 feet south of Gatling shaft, which at the time of last inspection was 23 feet high. The Tuttle shaft has been connected down to the fourth level. Work is also in progress in the Red shaft, stoping south on the 40 foot level, in oxidized ore.

All recommendations for safety have been carefully attended to, chief among which was the construction of a new magazine in a place of greater security. The official signal code is not in use, but its adoption was requested in conformity with the regulations.

THE ATLAS ARSENIC COMPANY.

The mines and works of this company, as previously stated, are situated upon a tract known as the Gatling Five Acres, entirely surrounded by the property of the Canadian Goldfields Limited. The ores are identical in character with those encountered in the Deloro mine. The shaft has attained a depth of 100 feet, being an increase of 15 feet. Level No. 1 northeast, has been lengthened 65 feet to a total of 185 feet. The southwest drift remains unaltered. Overhand stoping has been carried on in level No. 1, northeast, a slice 45 feet high and 125 feet long having been removed. A raise through this stope-block has also broken through into the

old surface workings, 20 feet southeast of the new mine. A power house has been erected 60 feet west of the shaft, having foundations 50 by 30 feet. This contains two rooms, one for the 80-h.p. boiler and a small duplex hoist, and one for a 9-drill duplex Rand air compressor. The old boiler-house adjacent has been converted into a blacksmith shop. A new dynamite magazine has been erected in accordance with the regulations in the Mines Act, 400 feet west of the power house, having a hill between it and the works. The stamp mill is temporarily idle, but will soon be in operation again. Instructions were given to put up a gate at the mouth of the old workings leading from the surface into the first level stope.

THE SOPHIA MINE.

The Sophia mine is the same as that referred to in previous reports under the name of the Diamond mine. Through the efforts of Mr. D. E. K. Stewart of Madoc this property has been placed upon a substantial footing, and is now owned by Messrs. Peter McLaren, Leopold Meyer, and Charles Meyer. It is being operated under the management of Mr. Leopold Meyer of Madoc. Its situation is seven miles east northeast from Madoc, and about one mile from Queensboro. The holdings of the syndicate consist of the west half of the east half of lot 14 in the tenth concession of Madoc, the west half and the west 20 acres of the east half of lot 15 in the same concession. There are two veins on the property, viz., the "mispickel vein," with a course due north and south, and the "free milling vein," running northwest and south east. The workings consist of the following : On the mispickel vein, No. 1 shaft, with a cross-section of 9 by 18 feet, and a depth of 60 feet. Drifting has just commenced at that depth. Hoisting is still done by hand windlass, operating a bucket on a skidway. On the free milling vein is the principal working shaft, known as No. 2. This has a cross-section of 9 by 10 feet, and a depth of 105 feet. There are two levels, the 60-foot and the 100-foot. On the 60-foot level there is a northwest drift 20 feet long, and a southeast drift 10 feet long. At the 100-foot level the northwest drift has been run 58 feet, and the southeast drift 10 feet. A skipway was being installed, and an inclined trestle carried the track to the upper part of the mill, where was located the hoisting engine. The skip will thus be drawn directly from the mine into the mill and then dumped. No. 3 shaft is also on the free milling vein. This is 60 feet deep, with the same cross-section as the other shafts. At the time of my visit this working was closed and full of water. It was kept securely fenced. Water was lifted by buckets from No. 1 shaft, but No. 2 was kept unwatered by a duplex steam pump. The ladder-way was being put into suitable condition, with a partition between it and the hoisting compartment.

The reduction works consist of a 10-stamp mill erected by the William Hamilton Manufacturing Company of Peterborough. The equipment comprises a 7 by 10-inch Blake crusher, 10 stamps of 900 lbs. each, a Wilfley concentrator, a 70-h.p. return flue boiler, and a 50-h.p. Corliss engine. There is also a blacksmith shop 100 feet south of shaft No. 2, and an assay office 150 feet south of this shaft. Dynamite was temporarily stored in a dug-out 300 feet south east of shaft No. 2. Instructions were given to promptly provide a suitable magazine at a distance of not less than 400 feet from any workings or structures.

HELENA MINES.

The Helena mines are situated 18 miles northeast from Kaladar in Barrie township, Frontenac county, embracing lots 19 and 20 in the sixth concession, and lot 20 in the seventh. The owners are Mr. Michael Seitz of Brooklyn, New York, and Mr. A. M. Chisholm, whose address is Cloyne P. O., Ont. The ores consist of copper and gold, in a quartz vein through crystalline limestone. The workings consist of three shafts. The "Hill shaft" is on lot 20 in the sixth concession. It is a two compartment inclined shaft, 16 by 12 feet in cross-section, and 125 feet deep. The angle of inclination is 45 degrees. The "Valley shaft" is 600 feet northeast from the Hill shaft, having the same cross section and inclination, and has also reached the

same depth. A drift has been run from the bottom of this slope, 25 feet east. The "Bill shaft" lies 300 feet north northeast from the latter working, and has attained a depth of 185 feet with a cross-section of 10 by 12 feet. This is a one-compartment shaft, with a ladderway not yet boarded off. Hoisting is done with steam hoisting engines at each shaft, and a 20-drill Rand air compressor is being installed at the Bill shaft. The power for this compressor is taken from a 16-foot water-fall on the Mississippi river. Extensive development of these mines is contemplated for the year 1901.

Copper Mines.

The continued high price of copper has led to active development of veins in several localities, and the present indications are that considerable quantities of copper will be produced from Ontario mines in the near future, independently of that obtained in connection with nickel in the Sudbury district. Outside of the aforesaid district copper veins of more or less promise occur in four fairly well defined zones in eastern Ontario.

In the eastern part of the Province copper is found at many points in Frontenac and Hastings counties. The Helena mines are the only ones in which important development has so far been made. The veins are usually well defined, containing chalcopyrite in quartz, with occasionally some bornite, and at a few places a little chalcocite and tetrahedrite has been reported. This district is one which apparently might justly deserve more attention than has hitherto been given to it. Gold occurs throughout it, and is generally associated with the copper.

The next belt towards the west is in the Parry Sound district. The veins occupy the lines of shear faults, and have produced considerable quantities of bornite near the surface. Development work has not yet been sufficiently extensive to demonstrate the value of the deposits, but the region is a promising one, and work is being prosecuted at a number of points which will soon show the character of the veins.

To the westward of the Sudbury copper-nickel group of mines there succeeds another group of veins carrying copper, with small quantities of gold in some cases. These are all highly siliceous ores, averaging about 4 per cent. of copper, and at one locality high-grade shipping ore was produced down to a depth of about 100 feet. The most easterly of these veins so far discovered is in the vicinity of Massey, and the most westerly at Bruce Mines.

The fourth group embraces those on Michipicoton Island, with which the writer is not familiar.

BRUCE MINES

This old, well-known group of mines has been acquired by the Bruce Copper Mines, Limited, of 31 Palmerston Building, Old Broad St., London, E.C. The area controlled consists of 5,000 acres held in fee simple, and mineral rights in 12,800 acres additional lying in the township of Plummer and Plummer Additional. The resident manager is Mr. William Braden, formerly of Helena, Montana.

The shafts have been renamed as follows:—No. 1, the old shaft northwest of the old Copper Bay or Bray shaft; No. 2, formerly called the Bray shaft; No. 3, formerly the Mitchell shaft; and No. 4, formerly the Scott shaft. The work so far done under the new management is the following: No. 2 shaft deepened from 420 to 435 feet, and at the 420-foot level a crosscut driven southwest 18 feet. In the same shaft, fifth level, the southeast drift has been prolonged 19 feet, and the northwest drift at the old caved ground is being straightened. In No. 4 shaft the old timbers, and the old Cornish pump rods and column pipe have been drawn, and temporary cribbing has been carried down 40 feet to facilitate cleaning out preparatory to equipping this for the main shaft to serve future mining operations on the property.

Work was only beginning, at the time of my visit, upon the surface plant, which is to be one of the most extensive in Ontario. Large hoisting works will be erected over No. 4 shaft,

in which will also be located the rock breaker. From this point the broken ore will be conveyed about a half mile to the new mill which will be erected near the site of the original concentrating works operated in the early days of mining at Bruce Mines. This mill will be equipped with the latest improved concentrating machinery, and will have a daily capacity of 400 tons. Close by the concentrator will be erected a smelting plant, consisting of ordinary blast furnaces and a refinery.

Dynamite was stored in the old stone magazine erected many years ago about one mile east of the mine. This contained a quantity of old black powder and other materials which had been left there for a long period. Instructions were given to clean this out, and destroy all old stock. It was also advised to provide a separate structure near the mine for a small supply of explosives for immediate use. Some minor recommendations were made concerning timbering in the mine, and attention was called again to the necessity of fencing off the old workings east of the Wellington vein.

ROCK LAKE MINE.

Important work has been done upon this property in the development of the ore bodies, and in the erection of surface plant, within the past year. The main shaft has been deepened to 420 feet, being an increase of 252 feet, the cross-section of 9 by 16 feet being maintained to the bottom. It is divided into three compartments—a manway and two hoisting compartments; one hoisting compartment being fitted with guides for a kibble crosshead, and one fitted up for a cage. The shaft is well trimmed up and securely timbered. The 100-foot level has been extended northwest 65 feet, giving it a length of 114 feet, while the southeast drift has been lengthened from 45 to 127 feet. The 200-foot level, started since my last inspection, has been driven 93 feet northwest and 76 feet southeast. The 300-foot level has been driven 26 feet northwest from the crosscut into the ore body, and crosscuts have been run from the 400-foot depth in the shaft, preparatory to drifting. A crosscut 27 feet southwest has been run on the first level, starting 110 feet from the shaft in the southeast drift, and another starting 113 feet from the shaft in the northwest drift extends 38 feet southwest. In the second level a crosscut 27 feet long extends southwest from the southeast drift, commencing at a point 74 feet distant from the shaft; and another, starting 90 feet from the shaft in the northwest drift, extends 27½ feet southwest. In the third level the crosscuts start from the shaft and extend respectively 37 feet northeast, and 38 feet southwest. The 20-foot extension of the shaft below the fourth level is used as a sump. In addition 27 open cuts have been made on the vein at intervals through a distance of two miles from the shaft to Rock lake, in a northwesterly direction.

A railroad has been graded from the mine down the gorge following the general direction of the vein and terminating at a mill site on the shore of Rock lake. A locomotive and other rolling stock had arrived at Bruce Mines station on the C.P.R., 12 miles distant, and was soon to be transported to Rock lake for the equipment of this line. (The rolling stock has since arrived on the ground.) The mill, or concentrating works, were in process of erection.

The mill will contain a 250-h. p. Corliss compound condensing engine, with three horizontal tubular boilers, and crushers, jigs, Wilfley tables, and accessory appliances. The capacity of the plant will be 200 tons of ore per diem. Accessory plant consists of a brickyard equipped with a pug mill and an improved Martin brick machine having a capacity of 10,000 bricks a day. This is located one mile west of the shaft. A saw mill is also erected adjacent to the brickyard.

In order to ship the concentrates from the mine to navigable water on lake Huron, the company has organized the Bruce Mines and Algoma Railway Company, Limited, and hopes to construct the line as far as Bruce Mines within the near future. This is a necessity for the economic operation of the property.

MASSEY COPPER MINE

This is the most recently developed copper mine promising permanent operation in the Province. The lode was uncovered in the southwest quarter of section 14 of Salter township, Algoma, and extends both eastwardly and westwardly for some distance in the same township. The entire property comprises 800 acres, and is owned by Mr. R. M. Thompson of New York and Major Robert G. Leckie of Sudbury. The same parties also own options on two water falls on the Sable river, 2½ miles from the mine, and on two falls near Massey, aggregating 2,000 h. p. The purpose of the owners is to operate air compressors on the Sable river, and transmit this power for use at the mines. The main shaft is on the southwest quarter of section 14, and is about three miles north- west from Massey. It has reached a depth of 80 feet, with a cross-section of 7 by 14 feet, being divided into a hoisting compartment and manway. Hoisting is done with a horse whim, operating a bucket on a skidway. A temporary whim shed and blacksmith shop have been erected at the shaft mouth.

The vein has been opened for a distance of one mile by test pits, revealing a continuous ore body in what is apparently a shear zone in the green schists, following the direction of fissility of the enclosing rocks. The lode is brecciated at places, the fracture planes having been healed with deposited quartz. The chalcopyrite however seems to bear no direct relation to these accidental quartz veins, being the result of replacement in the schist itself unassociated, so far as exposed, with any other gangue than the residual decomposed country rock. The lode is approximately parallel with the contact between the schists and the granite, lying from a few hundred feet to a quarter of a mile south of the contact between these formations The ore is said to vary from 3½ to 6 per cent. copper, with small amounts of gold.

The proposed treatment is to sort out the higher grade ore, shipping this to the new Orford smelter at Copper Cliff, where the silicious ore from Massey will be desirable in order to produce clean, relatively acid slags. The lower grade ore will be transported by an aerial tramway down grade to the Sable river, where it will be treated in concentrating works.

PARRY SOUND COPPER MINING COMPANY, LIMITED.

This company, controlling what are popularly known as the McGown mine and the Wilcox mine, has done some further development within the year, and latterly has revealed extensions of the ore body in the McGown property which give promise of permanence, although the mine is still in an experimental stage. The incline shaft, after attaining a depth of 160 feet was abandoned, and a new incline about 100 feet northeast of the former shaft was started towards the south, on an angle of 45 degrees. The main shaft, which is vertical, has reached a depth of 238 feet. At a depth of 160 feet is a level, driven 25 feet north northeast, and 30 feet south southwest. This is still in process of sinking. Hoisting is still done with a kibble, which is also used for lowering the men, the ladders being carried only to a depth of 85 feet. Five days were given as a limit within which a ladderway to the bottom must be provided, after which hoisting and lowering men in the bucket was to be prohibited. The hoisting engine was located in the same building which enclosed the gallows-frame. The official signal code was in use. Another test pit had been sunk 33 feet, with a cross-section 10 by 8 feet, on the shore of McGown lake, 200 feet southeast of the main shaft. The old discovery pit is also being deepened by an incline on an angle of 10 degrees toward the southwest, having reached a depth of 30 feet below the surface, the lower end being under the lake. Hoisting here is done with a derrick and horse whim, provided with a band-friction brake. Cribbing at the mouth of this pit was recommended to insure safety. Further ventilation was also advised for the dynamite magazine, which is located 500 feet south of the main shaft. The mill has been operated for a short period, but is now idle.

The Wilcox mine was closed at the time of my visit. Shaft No. 1 has been deepened to 132 feet, with a cross-section of 12 by 11 feet, collared to a depth of 20 feet. No drifting has yet been done. Shaft No. 2, situated half a mile east of No. 1, has been sunk 32 feet, with a cross-section of 10 by 8 feet, cribbed 20 feet. Shaft No. 3, 200 yards east of No. 2, has just been started, and is nothing more than open pit. Shaft No. 4 is 1,200 feet north of No. 1 and has been sunk 36 feet, with a cross-section of 10 by 8 feet.

GEORGIAN BAY AND NIAGARA COPPER MINING COMPANY.

Some development had been done during the summer of 1900 on a copper property in Christie Township, a few miles from Parry Sound, on the Christie Road. At the time of my visit work was suspended, and the shaft partly filled with water. The shaft was said to be 115 feet deep, and to be in a vein of bornite and cholcopyrite. The property is controlled by the Georgian Bay and Niagara Copper Mining Company, Limited, of Parry Sound.

ANGLO-AMERICAN COPPER MINING COMPANY.

A company with the above title has been organized, with offices in Parry Sound, to work a copper deposit on Wilcox island, opposite the Wilcox mine. A shaft had been sunk here 20 feet deep, with a drift 20 feet long.

Prospecting is also being prosecuted on Moon river, in Conger and Freeman townships, District of Parry Sound, 26 miles south of the town of Parry Sound.

Copper-nickel Mines

The activity in the copper-nickel district is greater than for many years past, resulting in extensive prospecting, and in the sale of many properties. The work so far done upon these deposits may be said to be quite superficial, however, and the future of deep mining here is quite uncertain. Diamond drill prospecting in depth has yielded mostly negative results, but this is inconclusive evidence of the non-existence of deeper-seated masses of ore. Considering the character and distribution of these deposits it would seem advisable to definitely settle this point by courageous exploration to lower levels than those yet reached.

THE CANADIAN COPPER COMPANY

Copper Cliff mine : This mine, the deepest in the district, has been carried down to the thirteenth level, making a depth from the surface of 972 feet, the distance between the twelfth and thirteenth levels being 115 feet. The increase of depth during the year has been 85 feet. A drift has been run from the bottom of the shaft 80 feet southeast. The double track skip-way has been extended to the full depth of the shaft.

On the twelfth level some back-stoping has been done in the second stope north, 30 feet above the floor of the level. Ore is also being shot down from the third to the tenth level, the open stope extending down so far. The masses broken down are block-holed and mucked out on the tenth level. On the first level the drift was extended a few feet into the hill, and then abandoned.

The pumping system now in use in this mine is as follows : A small Northey pump lifts water from the thirteenth to the twelfth level ; here it is lifted by another Northey pump to the tenth level ; whence it is sent to the seventh level by a Cameron pump ; another Northey pump lifts it to the fifth level, and by a larger Northey pump it is delivered to the surface. A large Knowles pump was about to be installed to lift the water directly from the seventh level to the surface, thus dispensing with the fifth level station.

A new underground dynamite magazine has been constructed in the old ninth level cross-cut. The door is kept locked, and the dynamite and exploders are stored in separate lockers in

the magazine. About 100 lbs of dynamite are stored at a time underground. The magazine is located 30 feet from the shaft, and is maintained in a cleanly condition, and comparatively dry.

An attempt was made to inspect the large stope with the aid of an acetylene lamp, but below the fifth level the atmosphere was too dense to see from wall to wall. The upper part of the stope, however, was clearly revealed and seemed to be secure. It is centrally supported by a rib, or inclined pillar, of irregular shape.

Evans mine : This mine has been stripped to the bottom, and is now closed, the pit being nearly filled with water. The engines, boilers, and other machinery have been withdrawn, and the pit and buildings left in a state of safety.

McArthur No. 1 mine : Work on the McArthur No. 1, and the southeast end extension, have been suspended and all plant and equipment removed. The pits have been fenced and the property left in safe condition.

McArthur No. 2 mine : The contemplated change in location of the shaft has been made. It now dips at a steeper angle, lying chiefly in the footwall back of the original position of the old shaft. It has been double-tracked for skip-haulage to the bottom, with a manway on one side. From the surface to the first level the distance is 130 feet, with an inclination of 42 degrees ; and from the first to the second level the distance is 65 feet with an incline of 72 degrees. Work on the first level is nearly finished, the ore having been stoped to the surface, leaving an open pit, which extends down to the second level. On the latter, ore was being broken on the sides of the pit and stopes were being extended back toward the footwall. Sinking below the second level was in progress, a solid arch of ore having been left temporarily as a protection over the lower part of this working, hoisting being done through a small opening on one side by means of an auxiliary hoist set up on the first level station.

The changes in the surface plant at this mine consist of a new coal shed erected at the hoisting works, measuring on the foundations 360 feet by 20 feet. A new magazine for explosives has been erected 500 feet southwest of the blacksmith shop. It is built of logs and is kept in good condition. Scaling of the shaft wall above the manway was recommended and it was also advised to widen the manway near the top.

Clara Bell group: Only two of the openings in this group of mines are now being worked, called respectively the South Pit and the North Pit. The South Pit is 40 feet south of the rock house and is 40 feet deep, 60 feet long and 50 feet wide. Hoisting is done by derrick, with a steam hoisting engine. The North Pit begins 100 feet north of the rock house and is 45 feet deep, 60 feet long and 50 feet wide. A skipway extends north from the rock house to the bottom of this pit, receiving also the ore dumped from an upper working higher up the hill. This latter is an open quarry, 35 feet deep at the back, 60 feet wide and 40 feet long. A double-track counterbalanced inclined tramway leads down to the lower pit, 180 feet in length. The equipment mentioned in my last report has been set up and is in operation. The dynamite magazine for these mines is located 600 feet west of the rock house, with a rise of ground between. It is built of wood, sealed with tongued and grooved narrow boards, and covered exteriorly with sheet iron, painted black. It is provided with double doors, but has no ventilator. A small preparation house for dynamite is located on the edge of a small pond about 500 feet north northeast of the rock house. This was not kept in as good condition as the other magazine. Greater cleanliness and a safer approach were recommended.

The McDonald mine was no longer in operation.

Stobie mine : The only enlargement of this mine since the last inspection has been due to stoping, and this has consisted almost wholly in working back the benches by the underhand methods here employed. The mine has been surveyed and maps made, for the first time reveal-

ing the true size and shape of the stopes and their relative positions clearly. The stopes are not superposed so as to weaken each other, and the mine appears safer than would otherwise have been judged. Work is temporarily suspended in the second level stope, and it was recommended to bar access to it by a guard rail. It was further advised to open a larger vent between the third and fourth level stopes, so as to improve the ventilation below.

No. 3 mine: This is the same as that previously referred to as the Six and Six mine. Development has been carried on at the westerly deposit by means of a shaft 7 by 17 feet, and 40 feet deep, inclining 62 degrees to the west. The shaft is provided with a manway and a double skipway, the skips being run in balance, operated by a drum in the power house. The shaft extends into a pit 30 feet deep, 65 feet wide and 80 feet long, open to the surface. There is also a stope northwest from the pit, 30 feet wide, 20 feet high and 15 feet long. A raise is being driven from this stope to the surface, to facilitate underground work during the winter.

The rock house is of the ordinary type used by the Canadian Copper Company, and is located just east of the shaft mentioned. It is 36 feet high, with foundations 45 by 26 feet. On the ground floor is located the engine, driving the crusher, screens and picking tables on the second and third floors. A trestle for disposing of waste rock extends 96 feet east from the building. The power house is a frame structure 80 feet north of the rock house. It contains a boiler room, and a hoist and air compressor room. The three boilers and other appliances in this building are those formerly in use at the Evans mine. There is a blacksmith shop 2C0 feet south of the rock house.

The standard gauge railroad of the Canadian Copper Company to the Stobie mine has been extended from the latter point to the rock house of No. 3 mine.

CANADIAN COPPER COMPANY'S SMELTER.

The new construction at the old smelting plant consists of the following: A frame storehouse for acids, 30 feet east of the assay office; coal sheds, 45 by 25 feet alongside the railroad trestle north of the old coke sheds; and a boiler house with a 50-foot iron stack, containing two 100-h p. boilers, located about 40 feet west of the assay office. All five furnaces in the plant were in blast.

The new or west smelter has been finished according to the plans described in my last report. Three furnaces were in blast, and a fourth was being set up. Three Connersville blowers were in operation, and a fourth was being installed for the new blast furnace.

A small foundry has been built just north of the west smelter, with an ordinary cupola furnace and other accessory plant.

Some changes have been made during the year in the personnel at the mines. Mr. James McArthur remains general manager, but the following new appointments have been made: financial agent, Mr. A. P. Turner; underground superintendent, Mr. John Lawson; master mechanic, Mr. Louis H. Thullen.

The following general recommendations were made:—To employ compressed air for underground pumping, particularly in the deeper levels, and in shaft sinking; to use greater care in keeping magazines clean, to provide all powder men with fuse cutters and cap crimpers; and to adopt a regular system for distributing explosive supplies to miners, so as to avoid sending dynamite into the mines at irregular times and by parties other than those specially appointed for this duty, so far as practicable.

GREAT LAKES COPPER COMPANY.

The following development work has been done upon this property during the year: The shaft has been enlarged to a section of 8 by 10 feet, and has been carried vertically to a depth of 71 feet. At a depth of 45 feet an inclined shaft continues at an angle of 45 degrees to

the north to a depth of 129 feet from the surface. This is still in process of sinking. One level has been driven at a distance of 75 feet from the surface measured along the vertical and inclined shafts. The east drift is 85 feet long. At a distance of 60 feet from the shaft is a crosscut 26 feet toward the north. A single acting Knowles pump, with a discharge pipe of 1¼ inches diameter, is located near the shaft in this drift. The west drift is 70 feet long, and also has a crosscut 28 feet long, starting 52 feet from the shaft and extending in a northerly direction. Hoisting is done by bucket on a skidway. The hoisting works are located 400 feet east of the shaft. The hoisting engine has a single drum, 21 by 22 inches, with steam cylinders 6½ by 9 inches, and winds a ⅝-inch steel cable. Power is taken from a 15-h.p. vertical boiler, which also supplies steam to the mine pump. The official signal code is used. The mine is ventilated by a 36-inch fan, located beside the mine mouth, and actuated by an independent engine.

The rock house is erected 300 feet southwest of the smelter, and contains a 15-h.p. engine and boiler and a Gates crusher. The smelter described in my last report is not in operation. A sleeping camp, 60 feet by 48 feet, well appointed in all particulars, has been erected 600 feet west of the smelter, and a boarding house has also been built 100 feet north of the sleeping camp. It was recommended that a larger cable for hoisting be installed without delay.

VICTORIA MINES.

This property, owned by Mr. Ludwig Mond, is located about 2 miles west of Whitefish, Algoma. The holdings are the following :—In the township of Denison, concession II, lot 8 ; concession III, lots 8 and south half of 9 ; concession IV, lot 8, and the north halves of 11 and 12 ; concession V, the south halves of lots 6, 8 and 9 ; in the township of Garson, Nipissing, concession II, the north half of the north half of lots 3, 4 and 5, and the northeast quarter of the north half of lot 6 ; concession III, the south half of lot 3, south half of lot 4, and the southwest quarter of the south half and the north half of the south half of lot 5. The approximate area is 3,000 acres. The staff consists of Mr. H. W. Hixon, general manager ; Mr. W. H. Holland, cashier ; Mr. A. B. Hixon, mine captain, and Mr. Jno. Grigg, master mechanic. The Victoria mines are located about 2 miles north of the new station of the same name on the "Soo" branch of the C.P.R.

Numerous pits have been opened on the vein, which is similar to those occurring near Sudbury. Four of these have been deepened as shafts. The trend of the deposit as revealed by these workings is east and west. The main shaft is called No. 11. It contains two compartments and a manway, with a total cross-section inside timbers of 5½ by 17 feet, and is 92 feet deep. The first level has been run off at a depth of 50 feet from the surface. Shaft No. 11 A is sunk 167 feet east of No. 11. It has only a single compartment and connects with the 50-foot level from shaft No. 11. A pump station is located on this level on the north side of the shaft. Shaft No. 10 is 270 feet east of No. 11 A, and is 45 feet deep. At this depth there is a drift north 23 feet. The first, or 50 foot level connects shafts Nos. 11, 11 A and 12, and extends 53 feet east of No. 11 A. The work is all neatly executed and safe.

A shaft house is in process of construction, which will be 38 feet high from the shaft mouth to the sheave blocks. About 20 feet distant is the rock house, 32 by 27 feet on the foundations, and 30 feet high. A tramway from the shaft house enters above the third floor, on which stands a 9 by 15-inch Blake crusher. On the second floor are the screens and picking tables, and on the first floor are the loading bins for discharging into buckets on the aerial tramway line that will conduct the ore to the roast yards. The power house is situated 20 feet south of shaft No. 11. It is divided into an engine room, 30 by 30 feet, and a boiler room, 30 by 20 feet. In the engine room is a duplex 50 h.p. double drum hoisting engine, winding a ⅞-inch steel cable, a straight line 5-drill Rand air compressor, and a 20-h.p. horizontal

engine for driving the machinery in the rock house. In the boiler room are three boilers, all of the locomotive type, one of 45-h.p and two of 60-h p. A blacksmith shop is located 150 feet east of the power house. The main dynamite magazine is 900 feet north of the shaft house, with a high hill between. It is built of logs and contains about six tons of dynamite. The explosives preparation house is 450 feet northeast of the shaft house, and contains one box of dynamite at a time. Blasting is done entirely with the battery. The mine office is situated about 600 feet south of the shaft house, and near by are the assay office and lodging houses for the workmen. General offices, residences, warehouses, etc., are being erected at Victoria mine station.

An aerial tramway is being installed by the Trenton Iron Company of Trenton, N.J. This will be 11,000 feet in length, taking ore from the rock house to the roast beds near Victoria mine station. A smelter is also being erected on a siding from the C P.R. at the station, and will contain two cupola furnaces, two converters and accessory plant.

GERTRUDE MINE.

The development of the Gertrude mine has been continued as indicated below. Shaft No. 1, with a cross-section of 8 by 12 feet, has attained a depth of 120 feet. At a depth of 47 feet a drift has been extended 50 feet south. The second level has been established at a depth of 102 feet. The south drift has been run 70 feet, and the north drift 20 feet. The lower 18 feet of the shaft constitute a sump. No. 2 shaft lies 3,300 feet west of No. 1. It maintains a cross section of 8 by 12 feet to a depth of 80 feet. Both Nos. 1 and 2 shafts were closed at the time of my visit. No. 3 working is a drift mine, located 600 feet west of No 2. It consists of a tunnel 65 feet long. This tunnel was not well drained, and connecting wire was used for leading wire for blasting. Recommendations were made touching both these matters. A 15-h.p. boiler was temporarily set up for supplying steam to the drill used in the tunnel. The exhaust was conducted by a pipe to the surface.

A temporary log power-house was located 150 feet northwest of shaft No. 2, containing a duplex single-drum hoist, and a 60-h p. boiler of locomotive type. A new hoist and air compressor for permanent work were on the ground, but not set up. A dynamite magazine has been erected 1,000 feet east of No. 1 shaft, in which were stored 3 tons of dynamite. Fuse and caps were kept in a store house near the boarding camp. The store and boarding house were located 600 feet southwest of No. 1 shaft.

The Manitoulin and North Shore Railway has been graded from Sudbury to a point near the Gertrude mine, a distance of about 12 miles. A spur is now being built to the mine, a mile and a quarter long. On the completion of the line from this point to Sudbury, which will be accomplished by the spring of 1901, active operations will be commenced at the Gertrude mine.

ORFORD COPPER COMPANY'S SMELTER.

The Orford Copper Company is erecting a smelting plant for the further refining of the matte from the furnaces of the Canadian Copper Company, the location of these works being 400 feet southwest of the old McArthur No. 1 rock house at Copper Cliff. It was expected to begin operations about November 1, 1900. The plant will consist of a crusher house for breaking up the matte, a roast shed, and a furnace house. The equipment comprises a Blake crusher, a Krupp ball mill, a Brown straight line roasting furnace, 165 feet long, with hearth 15 feet wide ; a 70-foot stack, a series of dust chambers, and two cupola furnaces. Power is supplied from two 125-h.p. boilers, and a 75-h.p. Atlas engine. There will also be a Cameron pump, a dynamo, and much additional apparatus, some of which is practically new in its application to smelting plants. The maximum capacity of the plant is calculated at 6,832 lbs. of high-grade matte per hour. The resident manager of the works is Mr. S. C. Lake.

In addition to handling the Canadian Copper Co's. matte, it is intended to reduce here also the ores from the Massey copper mine, previously mentioned.

IRON MINES.

The iron industry of the Province is assuming a more satisfactory aspect than ever before. The Helen Mine at Michipicoton yields an ore of very superior quality and the quantity in sight is so large as to insure permanent operations for a long period. The Eastern mines have also been producing more steadily than for many years past, and the outlook for an increased production is very favorable. It is encouraging to note also that more systematic development work is being prosecuted, resulting in establishing the mines, where this has been done, upon a surer footing for the future.

THE HELEN MINE.

The company controlled by Mr. F. H. Clergue of Sault Ste. Marie, Ont., has developed the Helen iron mine beyond the experimental stage to that of large and steady production. The ore-body has been proved to have a longitudinal extension of 1100 feet and a height above the level of Boyer lake, (on the east shore of which the mine has been opened), of 97 feet; and by diamond drilling it has been shown to extend at least 188 feet below the lake level. The only underground work conducted so far has been some drifting at the eastern end of the deposit. The main tunnel is 260 feet long, with two branches. The southwest drift begins 31 feet from the mouth of the tunnel, and extends 85 feet; and the northeast drift starts 50 feet from the tunnel entrance, and has a length of 35 feet. These workings are entirely in ore. The ore consists mainly of limonite and other hydrous oxides of iron, with an admixture of hematite. Its physical structure is admirable for smelting, being sufficiently hard to produce but little dust, and yet soft enough to admit of ready and rapid reduction in the furnace. The iron content averages about 58 per cent., the sulphur from 0.08 to 0.20 per cent., and the phosphorus from 0.011 to 0.067 per cent.

The actual mining is being conducted under contract by Messrs. Powell and Mitchell of Marquette, Mich., who employ about 400 men. At the time of my visit the ore was being hauled to the crusher above the railroad track, in tramcars drawn by horses, but a cableway was about to be put in operation, the towers being already in place. The span of this aerial cableway was to be 703 feet. The tower at the power station was 35 feet high, standing on a hill giving it an elevation above the railroad of 125 feet. The tower on the opposite side of the deposit was 70 feet high, with an elevation above the railroad of 115 feet. The crusher house stood 65 feet high, rising from the side of the track. At a height of 50 feet was located a Gates crusher, through which all ore passes to the loading bins below. The miners' camp consisted of a collection of buildings on a plateau above the railroad, behind the power station of the cableway. From here an inclined tramway for elevating freight extended 370 feet from the railroad to the plateau, which has an elevation of 150 feet above the lake shore. This is operated by a hoisting engine at the top. No dynamite magazine had yet been built at the mine, the explosive supply being kept in two open sheds at the western end of Boyer lake. The main supply of dynamite was kept in a magazine several miles distant, along the line of the railroad.

Ore from the mine is hauled to the docks at Michipicoton Harbor 11½ miles distant over a section of the Algoma Central Railway. In addition to the permanent way, there are 1¾ miles of siding. In the construction of this line the earth excavation amounted to 143,000 cubic yards, hard pan and frozen earth 12,000 cubic yards, clay 11,000 cubic yards, rock cutting 48,000 cubic yards. The total of all fills amounted to 180,000 cubic yards, and other fills are yet to be made. The track is laid with 85-lb. steel rails, with a ballast of sand and gravel. A trestle at present spans the Magpie river, which is to be replaced by a bridge now under contract, consisting of

three 80 foot spans. The maximum grade is 2.7 per cent., and the summit level at the mine is 653 feet above Lake Superior. The rolling stock consists of 3 Mogul locomotives of 52 tons each, 100 steel ore cars of 100,000 lbs capacity, 1 combination car, and additional box, dump, and flat cars. The engineer in charge is Mr. Henry F. Shipley.

At Michipicoton Harbor there is a wooden ore dock 275 feet long, owned by the Algoma Central Railway Company, containing 12 bins having a capacity of 50 tons each. The approach to the docks consists of a trestle 750 feet long, on a 12 degree curve The track is 40 feet above the lake level. The depth of water alongside the dock is 24 feet. Ore will be stored during the closed season on the sand plain, 4 miles from the harbor.

Four hundred feet east of the docks is a pier 600 feet long by 60 feet wide, on which is a warehouse 180 feet in length. The basin between the pier and the dock has been dredged out to a depth of 24 feet.

Nine hundred feet east of the dock is a sawmill having a capacity of 12,000 feet per diem. At the head of the pier is the company's office, and near by are a hotel and a company's store, owned by the Algoma Commercial Company. The operations of the company have resulted in the growth of a town of considerable dimensions around the harbor.

THE WILBUR MINE.

This property, located about two miles south of Lavant, on the Kingston and Pembroke Railway, has been in process of development throughout the year. The owner, Mr. William Caldwell of Toronto, has been carrying forward a plan of development, blocking out ore reserves, but doing no stoping. The exploratory workings however are wholly in the deposit of magnetite, which averages about 28 feet in thickness, and the output of ore from from the shafts and drifts has amounted to somewhat more than 6,000 tons, which is corded up along the siding from the railroad, no shipments having as yet been made. The stock pile has been sampled at frequent intervals, and is said to show an iron content of more than 60 per cent. with only a trace of sulphur and no phosphorus.

The new shaft, called No. 2, which was only being started at the time of my previous visit, is now 226 feet deep, on an incline of 27 degrees. At the bottom is a drift 40 feet long to the north, connecting with the bottom of the old workings, known as No. 1 mine. On the south side is a sump 20 by 12 feet and 8 feet deep, over which is located a Williams duplex direct acting pump, with a 2-inch discharge pipe. From No. 3 shaft, which is connected at two points with No. 2, as explained in my report for 1899, a new incline has been driven part way through to No. 2 shaft, serving as a sump for the drainage from this part of the mine. There are two levels started in No. 2 shaft, one at a depth of 100 feet, and another at 150 feet. The existence of ore in advance of the workings for a distance of 300 feet has been demonstrated by diamond drill borings.

The old No. 1 mine has been drained, revealing one long gallery at the bottom, with large stopes above, extending nearly to the surface. Pillars have been left, and walls of waste rock have also been built supporting the roof. The workings are secure in the lower part, but are somewhat treacherous near the surface. This mine, however, is not used for any purpose other than to afford further ventilation for the new workings, so that absolute security of the roof under the circumstances is unimportant. A roof fall here would not endanger any part of the new mine. The dynamite thawing house is now heated by steam, and is kept in good condition, but was left unlocked, to which objection was strongly made. The handling of all explosives is entrusted solely to the mine foreman. There is no ladderway in shaft No. 2, but there is a good manway in No. 3, which is the easier route for entering the mine. The surface plant remains unchanged. Attention was called to the absence of any brake on the hoisting drum, and it was urged to make good this deficiency at once.

THE ROBERTSVILLE MINE

The Robertsville mine, also known as the Lizzie mine, has made excellent progress under the mangement of the lessees, Messrs. F. W. Schwendiman and Thomas Barnes. No new plant has been erected, but the mine has been brought into a better condition, rendering it both safe and easier to operate. The old floor-arch formi g the floor of the first level has been removed, throwing the upper and lower stopes into one. The hanging wall has been scaled, and the skip-way has been extended to the bottom of the mine, making a total length on the incline of 194 feet. For a distance of 84 feet, the inclination of the skipway is 45 degrees, at which point it changes to a slope of 79 degrees. A ladderway follows the skipway to the bottom. The stoping chamber at the bottom measures 30 by 88 feet. Its widest point is 110 feet from the mine mouth, where it measures 57 by 108 feet. At the mouth it is 26 by 36 feet. As will appear from these dimensions the mine is only a deep open pit. There is still magnetite ore in considerable quantities on the foot wall of the stope, but the hanging wall is clean, sound country rock. Day and night shifts are being worked, using steam drills. The output of ore for a considerable period has averaged 40 tons per diem. At present the shipments amount to 50 tons a day, and the stock pile is estimated to contain 2000 tons. Dynamite is stored in an old frame house half a mile distant from the mine, and a small supply of about 300 lbs. is kept in a locked magazine 450 feet east southeast from the pit. Thawing is done in a proper manner with a hot-water thawer. The address of the lessees is Clarendon P. O.

THE ST. CHARLES MINE

This is a newly developed mine on lot 19, concession XI, Tudor township, Hastings County. The owners are The Anglo-American Iron Company, whose principal office is in Cleveland Ohio. The operators are the Cataraqui Mining and Development Company of Ontario, with offices in Madoc. The general manager is Mr. Chas. L. Meyer ; consulting engineer, Mr. Leopold Meyer ; and superintendent, Mr. Freeman J. Daniels of Millbridge. The directors are Hon. P. McLaren, Hon. J. McMillan and Mr. E. S. Leetham. The mine lies 5 miles north of Millbridge, and 1 mile southwest of McDonald siding on the Central Ontario Railway.

The ore is magnetite, with more or less calcite, occurring in an apparently well defined vein having a strike north 45 degrees west, lying between dioritic wall-rocks. The vein evidently occupies a position along a fault plane, with which is associated an intrusion of a dark, fine-grained basic volcanic rock There has been movement of the walls subsequent to the original ore filling, followed by deposition of calcite. This was shown by the crushed and broken hornblende crystals, healed by calcite. So much of the geology of the deposit was easily observable on a very superficial examination. A careful examination of the geology of this vein should prove highly instructive.

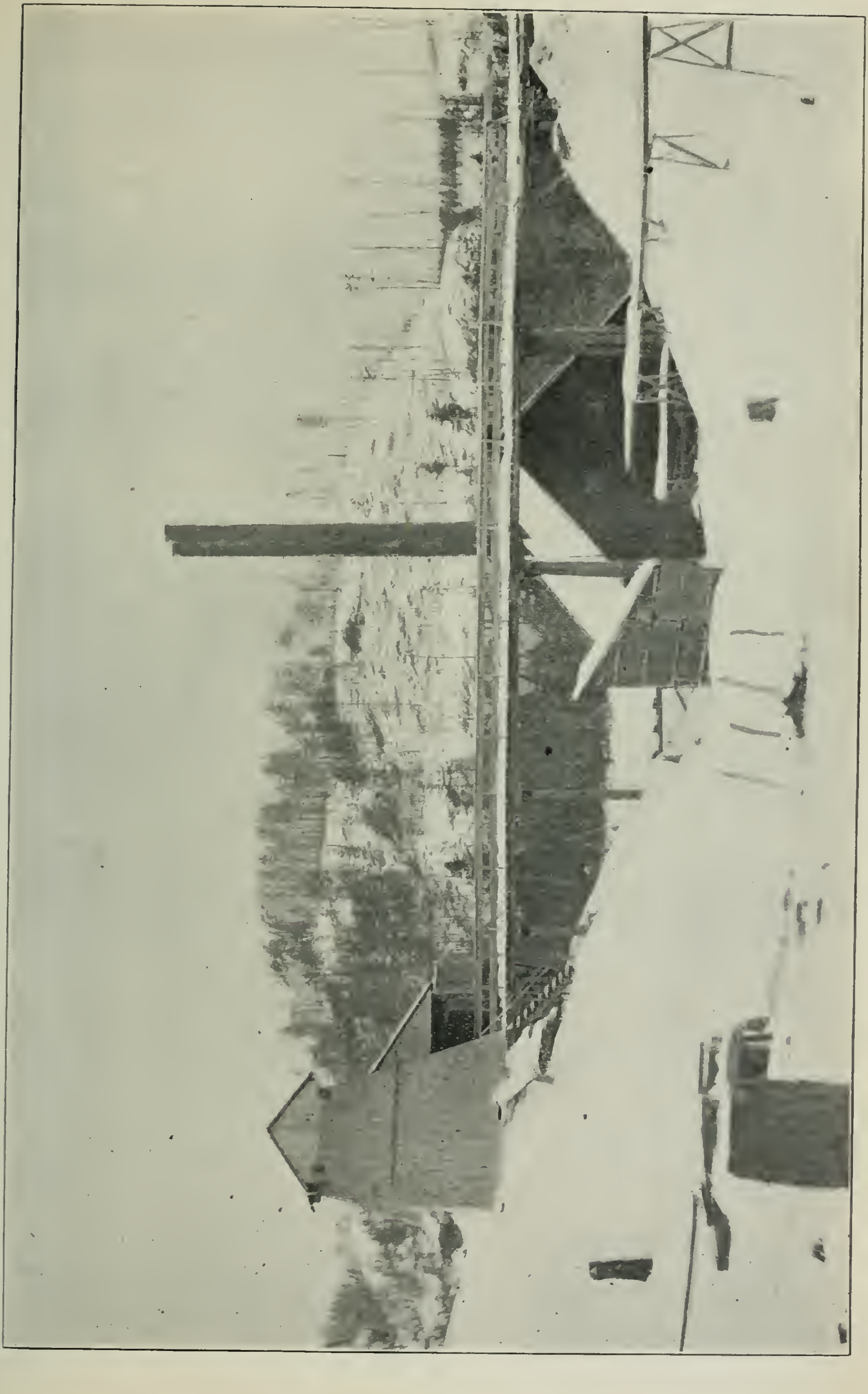
The workings consist of an open cut, with three pits, havi g a total length of 500 feet. The length of the outcrop as shown by a number of test pits is 1000 feet, with a width varying from 20 to 40 feet. During the season there have been shipped 3000 tons of ore from this mine to the Hamilton blast furnace, which gave an iron tenor of from 57 per cent, to 60 per cent., with some as high as 64 per cent. The ore contains no phosphorus, but shows from 0.5 to 1 per cent. of sulphur. There are at present 1500 tons of ore on the stock pile awaiting shipment. The high grade of the deposit is evidenced by the fact that in extracting the aforesaid 4500 tons only 200 tons of waste were culled. Hoisting is by derrick, and drilling is done with steam drills. Five hundred feet east of the mine is a boarding camp for 40 men, a blacksmith shop and a foreman's house. Dynamite is stored in a temporary magazine 500 feet north of the mine.

THE DUFFERIN MINE.

This property lying just southeast of the station of Malone on the Central Ontario Railway has been working during the season, under the direction of Chas. Bulpit for Thomas Barnes of

Belmont Gold Mine: Mill (30 stamps) from southwest.

 Stamp Mill at Belmont Gold Mine.



Hamilton. A tunnel 100 feet long has been driven, connecting with a shaft. The mine was producing 3 car loads a week until the Hamilton blast furnace was closed.

THE WALLBRIDGE MINE.

This mine, on the east half of lot 12, concession V, Madoc, is still in operation, with some promise of continuing to be a steady producer. The ore is a soft red hematite. Operations have been carried on for 4 months, yielding from 15 to 20 tons of ore per diem. The old shaft extending 35 feet below the present working, is now filled with debris, but will be cleaned out as mining proceeds. The depth from the edge of the pit to the working place is 60 feet. The side wall of the pit was apparently insecure, and instructions were left to set a row of stulls, and lag them closely, so as to protect the miners below. Hoisting is done by derrick. Dynamite was kept in a small building on the edge of the pit. The erection of a suitable magazine at a proper distance from the mine was required. The mine manager is Mr. Campbell Wallbridge.

THE SEYMOUR MINE

The Seymour iron mine was one of the earliest producers of iron ore in Ontario, and had been abandoned for many years. It is now being pumped out preparatory to active operation by Mr. Stephen Wellington of Madoc, who has obtained a lease of the property from the owner, Mr. Fred E. Seymour of Madoc. It is located on the west half of lot 11, concession v, Madoc township, 4 miles north of the town of that name. The old shaft is said to be 125 feet deep. The water had only been lowered to a depth of 40 feet at the time of my visit, revealing an old open stope 200 feet long east and west, varying from 18 to 22 feet wide, and dipping 60 degrees toward the south. The stope had once been well timbered up, but these timbers have mostly rotted and fallen. As was pointed out to the lessee, it will be necessary to set a row of stulls above the old level to insure safety. A 10-h.p. boiler now furnishes steam to the pump, and a horse whim is being set up for hoisting. The attention of the owner of the property was called to the regulation requiring the fencing of open workings.

This old open stope has remained unfenced for many years, and while no serious accident has resulted, the remains of cattle and sheep were found in the pit on pumping it out. It appears that practically no attention has been paid to the law on this subject, so far as old abandoned mines are concerned, throughout the Province. Nearly all such workings which I have visited have been found in the same condition as the Seymour mine, in this regard.

CALABOGIE MINES.

These mines, controlled by the Hamilton Steel and Iron Company, have been shipping on an average about 125 tons a day during the season. The pit has been but slightly deepened, the ore being extracted by enlarging its diameter.

The Calabogie Mining Company has also pumped out its pit which lies on an extension of the same deposit, and development has been progressing during a considerable part of the summer.

KATHERINE LEAD AND ZINC MINE.

This property is located on lot 7, concession XI, of Lake township, Hastings county, 3 miles north-west from Millbridge, embracing 300 acres. The owners and operators are The British Colonial Mining and Development Company of Ontario, Limited, with offices in Millbridge. The manager is Mr. Charles L. Meyer, with Mr. Freeman J. Daniels as superintendent. The directors are Messrs. Charles L. and Leopold Meyer, Col. Charles E. Turner and Mr. E. S. Leetham of Ottawa, and Hon. J. McMillan.

The vein carries argentiferous galena and zincblende in calcite, the average of the ore showing 10 ounces of silver. It lies wholly between walls of diorite, with a width varying from one to four feet, and a known longitudinal extension of half a mile. Explorations have been carried on by diamond drill borings to a depth of 292 feet, and by a shaft 125 feet deep, consisting of two compartments. For a depth of 50 feet it is vertical, and then inclines east 60 degrees. At 100 feet is a drift 100 feet to the north, with a stope 30 feet high and 50 feet long, beginning 10 feet from the shaft. Hoisting is done with a 25-h p. hoisting engine, taking steam from a 40-h.p. boiler. The shaft house is 22 feet square on the base, 12 feet square at the top, and 50 feet high. Adjacent is the boiler house, 60 feet by 25 feet. There is also a blacksmith shop, a boarding camp for 30 men, an office, and stables.

Half a mile south of the former shaft is the south shaft, 9 by 18 feet in cross-section, and 18 feet deep. The vein here is less highly mineralized, having however, a width of 9 feet, with 6 ore-bearing streaks, containing galena, but no zinc. The mines are at present idle, but work will soon be resumed.

Henderson Talc Mine.

A very interesting and important discovery of talc has been made at a distance of a mile and a half from Madoc on the north shore of Moira lake, by Mr. James E. Harrison of that place, by whom the property is being worked under lease. The location is on lot 14 concession XIV of Huntingdon township, Hastings county. The talc vein averages 36 feet in width, and has a strike north 40 degrees west, cutting across the strike of the tilted dolomite in which it occurs, the latter bearing north 10 degrees west.

The talc is of exceptionally fine quality, entirely free from grit, and being practically uniform across the full width of the deposit. Eight hundred tons of the material have been shipped to New York during the summer, representing nearly the total of all rock raised, the culls from this amount being only 5 tons. The shaft is now 43 feet deep, with a cross section of 18 by 20 feet. A pit head frame, closed in, has been erected over the shaft, with horse whim shed adjacent. Hoisting is done by bucket. Preparations were being made at the time of my visit to put in timbering, owing to the tendency to slips which were becoming dangerous. Dynamite was stored in a magazine 900 feet distant.

Canada Corundum Company, Limited.

Regular work has begun at the Corundum mine seven miles south of Combermere, by the Canada Corundum Company, Limited. The head offices of the company are in Toronto, with a branch office in Bridgeport, Connecticut. The officers are ; President, Clark Edwards, Bridgeport, Conn.; vice-president, J. H. Shenstone, Toronto ; and manager, B. A. C. Craig, Toronto. The superintendent of the mines and works is Leverett S. Ropes.

The properties being worked are in the 18th concession of Raglan, Renfrew county, known as the Robillard property. The company has also located 1,200 acres out of the 2,000 acres allowed by the Government. The mines are on lots 3 and 4, concession XVIII of Raglan, and the mill is half a mile southwest on lot 2. No underground development has so far been done, and in this case it will be unnecessary for a long period, the width of the deposit and the length of the outcrop over a high hill revealing a sufficient supply for many years, which may be cheaply obtained by quarrying. The rock extracted yields from 12 to 15 per cent. of corundum. It has been found that the rock containing the mineral fairly well disseminated in the form of relatively small crystals produces the finer grade of material, and the operations are being confined chiefly to that portion of the deposit where this character predominates.

The mill is situated on lot 2, consisting of the old W. E. James' saw mill remodelled for the purpose. The plant contains a No. 2 Gates crusher, a pair of 14 by 24-inch Gates rolls, 2 double-compartment Hartz jigs, a Wilfley table, and a Bartlett concentrator. With

this equipment the capacity of the mill is 20 tons of rock per diem. Additions are being made, the new equipment consisting of 3 Hartz jigs, 1 pair of Sturtevant centrifugal rolls, 16 by 6 inches, with a crushing capacity of 40 tons a day, and a magnetic separator for removing magnetite. The mill is driven by a 40-h.p. 5-nozzle Leffel water wheel of the hurdy-gurdy type, located 315 feet south of the plant, and 420 feet from the dam. The power is transmitted by a wire rope driver. The present mill is regarded only as experimental, and plans are under consideration for reconstruction at a point just below the mines, where ample dumping ground for tailings is available. This plan would involve the fluming of water from Echo lake, which would afford a large supply under higher head than can be had at the present mill-site. Other buildings on the property are an office and blacksmith shop near the mill, and a boarding camp midway between the mill and the mine. The dynamite magazine is located on the south-west corner of lot 4, five-eighths of a mile east from the mill. It is built of logs, well ventilated, but needed chinking and cleaning. It contained one ton of dynamite. The force of workmen employed numbered 45. A short road is being built from the mine 3 miles to Fransewa's landing on the York river, distant 4 miles from Combermere. Shipment of corundum from the works was to begin on October 5.

Mica Mines.

The interest in mica mining has grown to an extraordinary degree, due to the high prices for this mineral which prevailed until recently, and also to the fortunate circumstance that very remarkable deposits have been discovered in eastern Ontario.

The mica is found in all cases associated with more or less pyroxene, but the occurrences are further distinguished by the presence or absence of calcite. In some mines the calcite exists in veins of great width, the mica in such cases being confined to the wall rocks, or to "horses" in the calcite, associated with the pyroxene. In other cases the only accompanying vein matter is the pyroxene. These deposits are distributed in fairly well defined belts, mostly in the counties of Frontenac and Lanark. The most highly productive localities are east of Sydenham, Frontenac county, and 10 to 14 miles south of Perth in Lanark county. In these districts are some mines of considerable dimensions, and innumerable small pits worked in a desultory way by farmers.

A marked feature of the mica industry is uncertainty of output. A mine may suddenly acquire prominence as a large producer of exceptionally fine material, and in a few weeks or months the outlook may grow so discouraging that the mine will be abandoned. Again, mines which have been thus abandoned have been re-opened by courageous prospectors, with the result of discovering "bonanzas." It will be seen that no forecast as to the permanency of any mine can be made, and operators working a single property are in danger of sacrificing all previous profits by persistence in development work when the output falls off. The safest method is that pursued by F. W. Webster & Co., of Boston, who operate a large number of mines in the Province, which in the aggregate produce sufficient quantities of marketable mica to admit of taking chances in the development of properties not yet on a paying basis.

THE HANLAN MINE.

The Hanlan mine is on lot 11, concession VI, of Burgess, Lanark county, 10 miles south of Perth. It is owned by F. W. Webster & Co., with Richard Harris as superintendent. A shaft has been sunk 35 feet, with a cross-section of 16 by 10 feet, inclined 80 feet to the south.

The mica is in pyroxene, associated with iron-stained apatite. This mineral is a common accompaniment of a large proportion of the mica mines of the Province, but usually disappears at a relatively short distance from the surface. Many of the mica mines have been formerly worked as phosphate mines, at a time when the mica was not in demand.

Hoisting here is done with a derrick and a steam hoist, the hoisting engine having a 22 by 24-inch drum, winding a ⅞-inch steel cable. Steam is derived from a 20-h.p. upright boiler. Explosives were kept in a locked box 500 feet southwest of the mine. In addition to the main shaft there are a half dozen other pits on the property, the chief of which are a shaft 15 feet deep, 800 feet south-east, and another pair of pits each 15 feet deep on the same vein, 400 feet west of the latter. These veins all strike north 45 degrees east, the strike of the country rock being north 47 degrees 30 minutes east. The mica is mostly amber in color, with some of the white variety.

THE MARTHA MINE.

This is one of the oldest and most noted mica mines in the Province. It is located on the east half of lot 13, concession VI of Burgess, Lanark county, less than a mile from the Hanlan mine. It has been idle for a long time, but preparations were being made to pump it out and resume operations. It has been worked through two shafts, one of which is said to be 100 feet deep, and the other 130 feet deep. The owners are the Mica Manufacturing Company, of London, Eng., with Mr. Frank Fuller, of Ottawa, as manager.

THE BABY MINE.

This is another old mica mine, with a shaft said to be 130 feet deep, which is to be re-opened. It is located on lot 11, concession V of Burgess, Lanark county, on the south side of Long lake.

THE BYRNES MINE.

Only surface work was being done at this property, but a shaft had been sunk 80 feet, which was full of water. It is on lot 11 and the east half of 12, concession VII of Burgess. The owner and operator is Patrick Byrnes

Small workings are also being carried on at what is known as the Watts and Noble mine, on lot 4, concession IV of Burgess, owned by Norman S. Bentley, of Saratoga, N.Y. The lessees are Watts and Noble, of Perth.

THE PIKE LAKE MINE.

This is claimed to be the oldest mica mine in Ontario, having been opened and worked for this mineral 37 years ago. It is located a half-mile southwest of Stanleyville, nine miles from Perth, on lot 17, concession IX, of Burgess, Lanark county. It is owned by W. A. Allan, of Ottawa, and the Mica Manufacturing Company. The superintendent is John O'Neil.

There are three shafts or pits on the property in a cluster 20 feet apart, having depths respectively of 75, 84 and 55 feet, with irregular cross-sections of approximately 18 by 8 feet. There is also an old caved pit 60 feet deep about 100 feet south of th s group. These mines have been working continuously for nearly 30 years, the product, until last year, being sold for stove mica. Hoisting is done by derrick and horse whim. Dynamite was insecurely housed, and instructions were left as to provisions for safety in this regard.

THE BLACKALL MINE.

Operations were about to be begun by the Standard Mica Company of Toronto, on a property on lot 10, concession V of Burgess, recently acquired from John Blackall.

THE M'NALLY MINE.

This property is on lot 21, concession V of Burgess, 3 miles southwest of the Martha mine. The owner is John McParland, who has leased the mining rights to H. W. McNally of Westport. Mining is being conducted under the direction of Peter Quigley. The pit is 40 feet deep, of irregular shape near the surface, but drawn in to a cross-section of 20 feet by 30 feet

toward the b ttom. A horse whim and derrick were being erected. Directions were given as to the proper storage of dynamite and as to timbering. The output of this mine has been about 2½ tons of mica per week during the summer.

THE GOULD LAKE MINE.

Four and a half miles west of Sydenham are a number of old workings, and two comparatively recent shafts, which were being operated under lease by Webster & Co. until some time in the latter part of the summer. This is known as the Gould Lake mine, and embraces lots 6 and 7 in concession X of Loughboro.

The manager was Samuel Cordick, under whom were working 17 men.

Shaft No. 1 was on the west end of lot 6. It had reached a depth of 115 feet, with a cross-section of 8 by 12 feet. The level was at a depth of 60 feet, the east drift being 40 feet long, and the west drift 25 feet. From here stoping had been carried on nearly to the surface, with an average width of 12 feet. Shaft No. 2 was only a few yards distant and had been sunk 80 feet with a cross-section of 6 by 10 feet. At 50 feet from the top was a west drift opening into the workings of No. 1 shaft. No. 3 shaft was on the east side of lot 7. It was in reality an open pit 50 feet long east and west, and 60 feet deep. At a distance of 150 feet from this were two other open cuts 30 feet deep with a drift 12 feet north from the westerly cut. Hoisting from Nos. 1 and 2 shafts was done by a single derrick with a 25-foot mast and a 40-foot boom, having a 20-inch drum hoisting engine winding a 1-inch cable. Ingersoll steam drills were used in mining. The dynamite supply was kept in a small house 150 feet west of No. 1 shaft. There was also a blacksmith shop and a mica trimming house 80 feet north of No. 1 shaft.

WHEAL MARY MINE.

This mine is located on lot 5, concession XIV of Storrington, Frontenac county, 8 miles east of Stoness Corners. The owners are Mr. Joseph Bawden and Mr. Alexander Gunn, of Kingston, and the operator is Mr. Joseph Bawden, who has leased Mr. Gunn's interest. The workings consist of an open cut 25 feet deep, 40 feet long, and 10 feet wide. Hoisting is done by a derrick with a whip. The output for three months has amounted to 9 tons of crude mica, yielding cuts about 2 by 4 inches. Five miners are employed.

Other mines in the same locality are Raymond's on lot 22, concession XI of Loughboro, 1½ miles north of Stoness Corners, and Rowan's mine on lot 9, concession XIV of Storrington, 12 miles east of Stoness Corners, the latter working under lease to Mr. H. H. Gildersleeve, of Kingston.

THE SMYTHE MINE.

Three miles south of Bedford Mills, on lot 6, concession XIII of Bedford, Frontenac county, is the Smythe mine, owned by Dr. E. H. Smythe of Kingston, and leased to Mr. Jno. N. Glidden. Mining has been prosecuted here for 18 months, the workings consisting of a 25-foot vertical shaft, with an inclined shaft, 12 by 9 feet, communicating with the vertical shaft at the bottom. Hoisting is accomplished with a derrick and whip.

THE STONESS MINE.

A syndicate consisting of Messrs. Robert Kent and Joseph Franklin of Kingston, and Mr. Jabez Stoness of Stoness Corners, now control what was formerly known as the Buck Lake mica mine, located on lot 4, concession XII of Bedford. It is at the northeast end of Buck lake, about 9 miles from Stoness Corners.

The mine was opened 15 years ago for mica, and under lease to Webster and Co. was sunk to a depth of 30 feet. The shaft is now 440 feet deep on a 45-degree incline toward the north

northeast. There is also a vertical shaft 100 feet deep into the workings at the southeast end of the stoping chamber. Hoisting is done with a 20-h.p. engine, winding a $\frac{7}{8}$-inch steel cable, drawing a kibble mounted on a four-wheel truck. Steam is derived from a 50-h. p. water tube boiler. Drilling is done by steam drills. The lower part of the mine is quite dry, but water nearer the surface is drained to a sump at the bottom of the 100-foot shaft, and is pumped to the surface by a Northey pump, $4\frac{1}{2}$ by $2\frac{3}{4}$ by 4 inches. The average cross-section of the incline is 16 by 40 feet, and the stope varies from 30 to 40 feet in width, with an irregular elevation, at places reaching to a height of 60 feet. Above the mine is a building divided into rooms for the boiler, hoist, store-room, and for mica trimming. Dynamite is stored in a frame magazine 400 feet east of the shaft, with a hill between. A dwelling house of 8 rooms has also been erected 300 feet north northeast of the shaft.

The output of mica from this mine has been a ton a day for many months. The crystals of mica here are of exceptionally large size, and very free from blemishes. The body of the vein consists of pink calcite, the mica occurring along the walls between the calcite and the bounding pyroxene. The trend of the vein is about north northeast, cutting the gneissoid country rock. The mine is said to be the heaviest producer of fine mica in Ontario. The manager is Mr. Joseph Franklin, with Samuel Hunter as foreman. The number of workmen employed was 30.

The same parties are also doing development work at numerous points on lot 5 of the same concession, about a quarter mile west northwest of the Stoness mine, where the mica occurs in pyroxene without calcite.

The owners are contemplating the installation of a Taylor hydraulic air compressor at the falls on the outlet of Buck lake, 3,000 feet northeast of the mine, to develop power for all purposes at the works.

BIRCH LAKE MINE

On lot 14, concession XIV of Loughboro, Frontenac county, is a mine owned by Thos. J. Brennan of Schenectady, N. Y., and leased to Webster and Co. A pit inclining 80 degrees southwest, with a section of 12 by 24 feet, has been sunk to a depth of 80 feet. Hoisting is done by a kibble on a skidway, with a horse whim and derrick. A mica-trimming house was located 40 feet west of this pit, with a blacksmith shop near by. Explosives were improperly cared for, and instructions for safe-keeping were left with the manager, Sidney Orser, of Sydenham.

THE LACEY MINE

The old Lacey mine, on lot 11, concession VII of Loughboro, Frontenac county, has been reopened on lease by Mr. J. W. Trousdale of Sydenham. It is situated $3\frac{1}{2}$ miles northeast of that village. The owners of the mineral rights are the General Electric Company, of Schenectady, N. Y.

The workings consist of a single shaft 70 feet deep inclining 84 degrees east, and widening at a distance of 15 feet from the surface to a cross-section of 9 by 60 feet. Hoisting is by bucket and horse whim with a derrick. Unwatering is accomplished in the same way. Dynamite was stored in the blacksmith shop. Orders to provide a proper magazine were given both to the lessee and to the manager, J. H. Stanger. Advice was also given regarding necessary timbering in the mine. The shop and mica-trimming house were on a hill several hundred feet from the workings. The output from this mine has been an exceptionally fine grade of amber mica. From the months of June to November inclusive the yield of thumb-trimmed mica has amounted to 36,118 lbs., and the production is still 25 bbls. per diem, with no sign of diminution.

Other mica mines, concerning which information only has been obtained are the following:

Freeman's mine, lot 12, concession VIII of Loughboro.

Bear lake mine, owned by William Wallace, and John Roberts of Stoness Corners, 3 miles north of that village, said to yield very large cuts of fine mica.

Felix Benjamin mine, lot 6, concession VIII of Loughboro, a shallow working, but producing largely.

Grant and McClatchey mine, owned by Dr. John Grant and Prof. McClatchey of Napanee, and located on lot 7, concession X of Loughboro, on the east side of Gould lake.

Freeburn mine, on lot 3, concession VII of Loughboro, 2 miles north of Sydenham, now under water.

Boal's mine, on lot 8, concession XII of Storrington.

Frank Leushner's mine on lot 7 concession I of Bedford, the most westerly opening in the county of Frontenac.

Campbell and Folger's mines on lot 12, concession I of Oso, and on lot 27, concession II of Hinchinbrooke, near Eagle lake.

Tetts' Mica mine, owned by John and Benjamin Tetts, located on lot 2, concession VIII of Bedford, on the north side of Birch lake, 12 miles north northeast of Sydenham. This mine was for a period the largest producer of mica in the Province.

MICA TRIMMING WORKS.

The mica trimming works of Webster and Company at Sydenham handle the greater portion of the output of that region. A force of 20 men and women are constantly employed in this work. The manager of the works is Mr. J. E. Chown of Sydenham, who also has supervision of the trimming works of Webster and Company in Perth. The mica from both these localities is shipped to Ottawa, where it is finally prepared for export.

Another large mica trimming house is maintained by the Kent Bros. in Kingston, employing 16 hands.

[NOTE.—Newspaper reports were circulated in the mica mining districts of Ontario and Quebec during the latter part of 1900 of new and important sources of mica supply having been opened up in New Hampshire, South Dakota and North Carolina ; sources, it was stated, quite capable of supplying the entire market of the United States. Inquiries made in official and well-informed quarters brought the reply that while there was an increased activity in mica mining in the United States, it was doubtful whether the product of sheet mica in 1901 would show more than 50 per cent. of an increase over the yield of 1900. Most of the shipments made in the latter part of 1900 were of scrap mica gathered up from the old mines of South Dakota and a few new ones opened up in the Black Hills. The same conditions also existed in New Hampshire. No mica had been mined in South Carolina for several years, and while the output of North Carolina was being increased, it was not likely to be 50 per cent. larger.

In the Summary Report of the Geological Survey Department for the year 1900, p. 8 *et seq.* mention is made of the fact that mica from India is used almost exclusively by English manufacturers of electrical machinery. Some specimens of Canadian amber mica were forwarded to Prof. Wyndham R. Duncan, F.R.S., Director of the Scientific and Technical Department of the Imperial Institute, London, for special examination by experts. Prof. Duncan's report fully bore out the opinion formed as to the exceptionally high value of this mica for electrical purposes. "General physical and chemical examination showed that the samples were uniform in character, pliable and softer than much of the mica which appears in the English market. . . . . On the general question of the uses and comparative value of the Canadian amber mica, the brokers remark that this variety of mica is of no other value than for electrical purposes, its special value being principally due to its softness and easy lamination. They are of opinion that Canadian amber mica is of greater value for electrical work than most of the Indian mica that comes to this country. They remark, however, that there are two or three varieties of Indian mica, such as white Bengal, Cochin, from the west coast of Madras and Ceylon amber mica which compare very favorably with Canadian product, whilst the selling prices of these Indian varieties are often from one-third to one-half those asked for the Canadian mica. They confirm the opinions expressed in Dr. Dawson's letters of February 16 and April 4 of this year, that Canadian miners obtain a better price in the United States than in the London market, chiefly from the circumstance that American electricians prefer the Canadian product which is close at hand and can be depended upon for unit formity of quality and regularity of supply. Although circumstances point to the United States as being the natural outle of Canadian mica, nevertheless it would be worth while to take steps to make it better known in the British market, since there are several factors operating against the Indian product, especially in the matters of tariff and regularity of supply." The samples reported on by Prof. Duncan appear to have been all from the Province of Quebec, but mica from eastern

Ontario is identical in constituents and composition and equal in quality. In view of what seems to have been concerted action on the part of mica consumers in the United States to "bear" the prices of Canadian mica last year, it might be well for miners of the article both in Ontario and Quebec to give more attention to the English market for their product than they have hitherto given.—T.W.G.]

MICHIPICOTON MINING DIVISION.

BY D. G. BOYD, INSPECTOR.

I have the honor to present to you herewith the fourth annual report on the Michipicoton Mining Division. The past season has been the most successful since the division was set apart in 1897, mainly owing to the operations of the Algoma Central Railway Company, and other companies under the same management.

The railroad was completed from the Harbor to the Helen iron mine, a distance of twelve miles, and is equipped with five locomotives and one hundred fifty-ton steel ore cars, besides flat and box cars, and one combined passenger and baggage car. An ore dock was built (with 12 chutes but no storage capacity) which will be added to and improved Four steel steamships with a capacity of 2000 tons each were purchased in England, and were employed from the middle of July, when the first shipment of ore was made, until the end of the season in carrying iron ore to Midland. Besides the ore dock, a large commercial dock was completed, and warehouses, offices, and all the buildings necessary for the nucleus of a town were built.

The Helen iron mine was in operation all season and employed from 400 to 500 men, the output for the season being upwards of 60,000 tons.

By a ruling of the Commissioner of Crown Lands dated 3 May, 1900, all licensees who had discovered iron ore between April 30, 1899, and April 30, 1900, were required to file their claims on or before June 16, 1900. This was done in order to give licensees who had staked iron claims during the period when the iron lands were withdrawn, an opportunity to put their case before the Department so that the latter might be apprised of the facts and have such information before it as would enable the situation to be dealt with. The result of this ruling was the filing of 68 claims.

On June 22, 1900, an Order-in-Council was passed revoking the Order-in-Council of July 10, 1899, thus placing the iron lands in the market again.

The office at Michipicoton River was opened on May 14, and continued open until November 6. During this period 176 miner's licenses were issued and 428 mining claims registered. The total number of licenses issued during the year, including renewals, was 271, 65 licenses being issued from Toronto. The total number of claims registered was 452, of which number 24 were registered at Toronto while the office at Michipicoton was closed. The amount of money forwarded to the Treasury Department from the office at Michipicoton was $4,480.50, and the amount received at Toronto was $2,185, making a total of $6,665.50, being $1,686.50 in excess of the amount received for the year 1899. Of this amount $2,710 was received for miner's licenses, $3,165.50 fees for additional mining claims, and $185 fees for transfer of claims. The balance, $605, was paid in on account of patent fees, at the rate of $2 per acre, by licensees who had fulfilled all the conditions required and desired to obtain a patent for their claims.

Helen Iron Mine.

This mine, the property of the Lake Superior Power Company, is worked by Messrs. Powell and Mitchell of Marquette, Michigan, who began operations about the middle of May. They have installed the following machinery : (1) One No. 8 Gates crusher, having a capacity of 125 to 200 tons of ore per hour, driven by a 250-h.p. Corliss engine, the steam for which is supplied by two tubular boilers, 125-h.p. each. The crusher was started on July 12. (2) A Lidgerwood cableway has been erected over the ore body, the head tower being 35 feet high, and the tail tower 65 feet high, with a span of 735 feet. The conveyor is driven by a Lidger wood friction drum hoist, 75-h.p. double engine with cylinders 10 by 12 inches, and has an equipment of 26 skips with a capacity of four tons each. (3) Six hand steam drills, the steam for

which was supplied from the boiler house. (4) An inclined railway was built for hoisting supplies from the station on the railway to the camp, which is situated 150 feet above the level of Boyer lake. The car is operated by a Lidgerwood double friction drum hoist with 7 by 10-inch cylinders. (5) An electric lighting plant consisting of a 75-h.p. Corliss engine and a Westinghouse dynamo with a capacity of 750 lights, 16-candle power each. The dining room, engine house and workings are lighted by electricity.

The principal building is a combined dining hall and kitchen 200 feet long by 40 feet wide. The kitchen and bakery are situated in the centre of the building with the dining hall at both ends. The kitchen is supplied with all the latest improvements in cooking utensils. Three sleep camps, 60 by 30 feet and two stories high, each of which will accommodate 75 men, have been built, while one more of the same size is to be erected. Besides these, there are numerous other buildings, including a combined engine, boiler, and crusher house, sleep camps, offices, warehouses, and residences etc. A large three story building, 75 feet square was being built for the purposes of a machine, tool, and carpenter shop.

The ore body has been stripped for a distance of 500 feet east and west, and 260 feet north and south. The highest elevation above lake Boyer is 100 feet. A diamond drill was employed during the winter, and Mr. E. V. Clergue told me that the depth of the deepest hole drilled was 198 feet below the level of Boyer lake. Two other holes were drilled over 100 feet deep, the cores showing all ore. The underground workings consist of a tunnel 3½ by 6½ feet in size, 260 feet in length, running in an easterly direction with branches, one 35 feet from the entrance running 90 feet in a northerly direction, and another 65 feet from the entrance running 30 feet in a southerly direction. At the time of inspection, October 22, the ore was being quarried, loaded into skips and conveyed by the cableway. It was dumped into the crusher and when crushed fed directly into the ore cars. The amount of ore shipped up to the time of my visit was 50,000 tons. The number of men engaged in mining was 275, working in two shifts, and the output was about 900 tons per 24 hours, Over 500 men were employed at the mine, the balance working on buildings. Mr. Arthur Mitchell is superintendent. Mr. S. S. James, B.A.Sc., O.L.S., is engaged at the mine in constructing a waterworks and sewage system, and also laying out a site for a town.

Other Developments.

"Zagloba" claim, No. 602, situated six miles east of the mission, and about one mile north of the falls on the Michipicoton river, was visited on November 2. The property is owned by the Waterloo County Mining Syndicate. Mr. E. A. Douglas, A.R.S.M., is consulting engineer, and Mr. T. Huson Murray, resident manager. The vein, which occurs in the granite near the contact, has been traced across the claim a distance of 20 chains, with a strike of west northwest and east southeast, dipping 45 degrees to the east, and has an average surface width of five feet. At the time of my visit the shafts were full of water, operations having ceased until machinery could be installed. The following particulars were given me by Mr. Douglas : the main shaft is 6 feet by 8 feet, with a depth of 125 feet, timbered down to a depth of 40 feet. The shaft follows the course of the vein, which becomes more perpendicular as depth is reached. At the 80-foot level a drift was made 25 feet in length each way. At a distance of 100 feet south of the main shaft, a shaft 6 by 8 feet was sunk 25 feet, and 500 feet north, another shaft 6 by 8 feet was sunk 35 feet deep. Besides the shafts the vein has been stripped and opened up in three places between the main shaft and the 35-foot shaft. On a parallel vein four feet wide, situated 200 feet east of the main vein, some stripping has been done, also on another parallel vein 150 feet west of the main vein.

The following buildings were erected : sleep camp, cook camp, office, storehouse, dynamite house, stable and blacksmith shop. The mine has been closed down until a pumping, hoisting and steam drilling plant can be installed, when operations will be resumed.

South of and adjoining the "Zagloba" claim is the "Continuity" claim, which is situated on the continuation of the "Zagloba" vein. It is owned by Mr. L. E. Lum, of Duluth, Minn., and is being developed by Mr. R. W. Seelye of the same place. The vein has been traced and stripped in places for a distance of 600 feet, and a shaft sunk 22 feet deep.

Sleep camp, cook camp, engine house, store house, and powder house have been built, and the following machinery installed : (1) a Jenckes 18-h.p. upright boiler ; (2) one Jenckes special 6-inch hoisting engine ; (3) one No. 5 Cameron pump ; (4) a No. 2 Little Giant Rand steam drill. The machinery was ready for use on the November 5. Work will be carried on all winter with a gang of ten men.

On the "Gananoque" claim, No. 128, the main tunnel was driven a further distance of 19 feet, following the vein, making the total length of the tunnel 53 feet. A second tunnel was drifted a distance of 20 feet through the rock to strike the vein. Mr. Joshua Legge was in charge of the operations.

The shaft of the Minto mine was full of water at the time of my visit on October 25. Mr. Ernst, the manager, informed me that it had been sunk to a depth of 130 feet. Work ceased at the end of June, and will not be started again until more powerful machinery can be installed.

Claim 319, "Mariposa," was visited on October 24. It is owned by Messrs. W. H. Lewis, of Detour, Mich., and A. B. Blackinton, of Michipicoton River, and is situated about five miles east of the mission. On the vein, which has a course of northwest and southeast, with an average width of 8 feet, and has been traced across the claim, a shaft 9 by 11 feet has been sunk a distance of 33 feet, and two pits have been put down, each 11 feet deep.

The Algoma Commercial Company started work on claim No. 1052, named "The Grace," in July. The vein is a small one, averaging two feet wide on the surface, with a course of north northwest and south southeast, dipping about 60 degrees to the east. It is very richly mineralized with free gold and also carries iron and copper pyrites. Shaft No. 1, which will be the working shaft, is 7 by 11 feet in size. At the time of my visit, on October 25, it was 35 feet deep, and was being timbered. At a distance of 197 feet to the north, shaft No. 2 was sunk, 7 feet by 11 feet, and 18 feet deep. A large camp, 20 by 24 feet, two stories high, was built, as well as several smaller buildings. Machinery has been ordered, and work will be pushed vigorously. Mr. P. N. Nissen is in charge.

West of Iron lake, on Dog river, on the claims owned by Mr. A. C. Ely, of Chicago, a gang of 20 men, in charge of Mr. Robert Murray, were engaged in prospecting. The work consists of stripping, test-pitting, trenching and drifting. The locality was not visited. Mr. Murray informed me that they had not located any large body of ore, but that he considered the indications excellent.

On Paint creek, about nine miles easterly from Iron lake, the Algoma Commercial Company had a gang of 25 men engaged in prospecting, stripping, trenching and test-pitting claims on the iron range. The work was in charge of Mr. G. H. Brotherton, of Port Arthur. Camps were built on Iron lake by the same company preparatory to starting work in the vicinity.

Other claims were visited, but the work done was not of sufficent importance to be noted here.

Appended is a list of licensees, place of residence, number of license, and number of claim (if any) registered during the year. Where not otherwise indicated the licensees are resident of Ontario. Claims marked with an asterisk (*) are in dispute.

The uncertainty as to the position of iron ore claims staked out while the withdrawal order was in force has not yet been removed by a decision from the Department. This uncertainty affects a number of the claims enumerated in the list not specially marked.

List of Licensees.

Name.	Residence.	No. License.	Claims.
Abell, J.	Toronto	805	676.
Allen, J. E.	S. S. Marie	914	
Andre, G.	Michipicoton River	865	
Armstrong, H. A	Michipicoton River	807	
Armstrong, W. J	Guelph	9[illegible]7	943, 946, 1,039.
Bacon, B. T.	Chicago, Ill	889	794.
Bain, W	Toronto	732	990.
Barnham, B.	Duluth	744	
Barton, F	Michipicoton Harbor	781	1,132.
Barton, S.	S. S. Marie	933	797, 1,099, 1,100.
Becker, O.	New York, N.Y	856	
Becker, Mrs. O.	New York, N.Y	859	1,086.
Beebe, W. D.	Pleasantville, Pa.	792	714, 1,048.
Bell, M. E.	Ansonia	844	
Blackinton, A. B	Michipicoton River	926	942, 1,047, 1,107.
Bole, B. P.	Cleveland, O.	890	790.
Boucher, L.	Wawa	852	998.
Bousquet, J.	Wawa	937	843, 847.
Bowden, J. L.	S. S, Marie	959	814, 885, 895, 932, 939, 1,031.
Boyer, B.	S. S. Marie	915	
Bradford, F. E.	Michipicoton Harbor	764	1,058.
Brooks, A.	Michipicoton River	843	
Brotherton, G. H.	Michipicoton Harbor	868	852, 858, 859.
Brown, A. F.	Michipicoton River	942	883, 958, 1,040, 1,138.
Brown, Jane	Michipicoton River	878	
Brown, W. J.	Wawa	710	
Bryan, H. J.	S. S. Marie	867	1,071.
Buckley, H.	S. S. Marie	978	
Buxton, E. T.	S. S. Marie	909	
Cameron, A.	White River	953	827, 829, 833, 909.
Campbell, N	S. S. Marie	719	
Cash, D. G.	Duluth, Minn	740	
Cash, J. S	Duluth, Minn	741	
Chitty, A. H.	S. S. Marie	958	888, 901, 925, 1,018, 1,025.
Clark, E. D.	Guelph	986	944.
Clark, S	Duluth, Minn	725	
Clergue, B. J.	S. S. Marie	896	724, 770, 779, 1,075, 1,152.
Clergue, E. D.	Michipicoton Harbor	845	754, 805, *860, *863, 966, 967, 968, 1,041, 1,050, 1,051, 1,052, 1,122, 1,123.
Clergue, F. H.	S. S. Marie	849	769, 777, 807.
Clergue, Gertrude	Bangor, Maine	971	892, 906, 931, 969.
Clergue, Grace	Bangor, Maine	970	893, 907, 937, 970, 1,023, 1,094, 1,098.
Clergue, Helen	Bangor, Maine	969	896, 908, 935, 936, 940, 1,028, 1,057, 1,063.
Clergue J. H.	Bangor, Maine	897	775, 941.
Cochrane, R. B.	Marquette, Mich.	842	868.
Cook, C.	Brantford	957	
Corona Mining Co., Ltd.	Almonte	840	997.
Cottrell, R.	Michipicoton Harbor	831	
Coughlin, R	Michipicoton Harbor	865	
Cournager, N	Michipicoton Harbor	830	
Culbert, D. S.	Wawa	778	965, 1,043, 1,101, 1,110.
Davidson, J.	Ottawa	947	881, 964.
Davis, J	Wawa	712	*1,144.
De Haas, N. G	Marquette, Mich	729	987.
Derry, P. A	S. S. Marie	853	

LIST OF LICENSEES.—*Continued.*

Name.	Residence.	No. License.	Claims.
Detweiler, D. B.	Berlin	769	803, 959.
Detweiler, N. B.	Berlin	768	876.
Dickson, J. L.	Michipicoton Harbor	895	1,104 1,105, 1,117.
Donovan, J.	Pembroke	827	1,083.
Douglas, E. A.	Michipicoton River	804	716, 734, 1,154.
Downey, L.	Chapleau	851	842, 848.
Doyle, J. P.	Wawa	779	
Drew, T. F.	S. S. Marie	956	781.
Dunnett, S. C.	Duluth	745	
Dycie, J. G.	Michipicoton River	776	875, 1,085.
Dycie, M.	Michipicoton River	7[illegible]1	1,072.
Eccles, Ida	S. S. Marie, Mich	806	
Edey, M. C.	Ottawa	943	819, 877, 1,128.
Edey, R. W.	Michipicoton Harbor	945	879, 882, 947, 951, 955.
Ely, A. C.	Chicago, Ill	821	786.
Evans, R. B.	Michipicoton Harbor	862	995.
Ewing, W.	S. S. Marie	839	873.
Fay, J.	Marquette	735	989.
Flannigan, J. L.	Wawa	761	
Fleming, S. E.	S. S. Marie	935	709, 730.
Francis, G. F.	Pakenham	913	1,102.
Ganley, J.	S. S. Marie	791	
Gemmell, L. J.	Perth	777	
Gemmill, D. W.	S. S. Marie	980	
Georgi, J.	Michipicoton River	901	822.
Gibson, A.	Duluth, Minn	713	7[illegible]5.
Gibson, T.	Duluth, Minn	736	
Gilbert, F. L.	S. S. Marie	980	
G. N. M. and D. Co.	Toronto	782	
Godon, A.	Missanabie	793	1,003, 1,007, 1,011, 1,015.
Godon, Elise	St. Anne Pirade, Quo	885	1,088.
Godon, J.	Missanabie	794	1,002, 1,005, 1,009, 1,013.
Godon, N.	Missanabie	795	1,006, 1,010, 1,014.
Godon, T.	Missanabie	866	764, 766.
Goetz, A.	S. S. Marie, Mich	902	738, 744.
Goetz, Mrs. A.	S. S. Marie, Mich	903	739, 742.
Goetz, G.	Detour, Mich	857	*741, 746.
Goetz, Johanna	Detour, Mich	718	740, 745.
Goetz, Mary	Detour, Mich	857	*743, 747.
Gondreau, M.	Wawa	775	
Goodwin, W. B.	Michipicoton Harbor	863	1,017.
Gordon, W. C.	Michipicoton Harbor	864	
Gowans, R.	Toronto	733	
Grant, G. H.	Victoria, B.C.	802	1,035.
Gray, A. N.	Woodstock	934	1,155, 1,156, 1,157.
Grover, M. B.	Wawa	771	891, 900, 916, 1,026.
Guelph Mfg. Co., Ltd.	Guelph	985	
Hall, C.	S. S. Marie	951	
Hall, I. D.	Thessalon	854	960.
Hall, W.	S. S. Marie	846	809, 816, 817, *861.
Hamilton, H. C.	S. S. Marie	973	894, 927, 930, 1,022.
Hamlin, F.	Chicago	950	977, 985, 986, 1,004, 1,008, 1,012, 1,016.
Hamwell, A. M.	S. S. Marie	961	810, 889, 898, 934, 1,020, 1,033.
Harrison, W. L.	New York, N.Y.	952	774, 776, 973, 981, 1,147.
Harvey, J.	Hamilton	879	
Hassard, R.	Toronto	720	

List of Licensees.—*Continued.*

Name	Residence.	No. License.	Claims.
Holbrook, H. B.	Wawa	871	*1,146.
Holbrook, L. J.	Watford	855	963, *1,145.
Holgate, W. A	Duluth, Minn	748	
Hoyt, J. H	Cleveland	728	988.
Hunt, J	Rydal Bank	923	1,084.
Hussey, J	S. S. Marie	838	874.
Husson, W.	Guelph	991	801, 824, 945, 1,038.
Irving, jr., T. C.	Michipicoton Harbor	772	780.
Keeley, C.	Wawa	850	
Keenan. C.	Michipicoton River	826	
Kees, W. H	Cleveland, O.	876	
Kensie, O	Berlin	770	
Kimball, Hattie	Michipicoton River	927	
Kimball, W.	Michipicoton River	786	
Kimball, jr., W.	Michipicoton River	787	911.
Kinnushaw, A.	Michipicoton River	834	1,108, 1,137.
Kitchener, B.	Michipicoton River	881	
Krelintz, F. M	Duluth, Minn	757	
Labelle, J	Michipicoton River	790	820, 838, 1,068, 1,081.
Lalonde, F.	Michipicoton Harbor	809	912, 921.
Lalonde, J.	Michipicoton Harbor	810	922.
Lauzon, A	S. S. Marie	772	796.
Lawlor, J. A	S. S. Marie	817	
Leferre, E	Missanabie	882	
Leferre, L	Missanabie	884	
Lefforriere, L.	Missanabie	785	924, 1,124.
Legge, C. H.	Gananoque	938	763, 1,119.
Legge, J.	Gananoque	929	762, 1,118.
Lesage, J.	Garden River	828	
Lewis, jr., A. E.	Milford, Penn.	908	
Lewis, F.	Michipicoton River	905	1,109.
Lewis, F. S.	Philadelphia, Pa.	972	
Lewis, W. H.	Detour, Mich	819	
Loper, J. H	Duluth, Minn	919	
Lum, L. E.	Duluth, Minn	877	
Lynch, J. A	North Bay	894	1,073.
McCue, W.	Duluth, Minn	874	
McDonald, N	S. S. Marie	837	872.
McDougall, L	White River	954	828, 832, 1,142.
McDougall, W. H.	White River	824	826, 831, 910.
McGillivray, W.	Ottawa	944	878, 1,130.
McKeehan, H. H	Cleveland, O	875	783.
McKinnon, C. A	S. S. Marie	979	
McLean, A.	Wawa	767	1,061.
McNeill. E. W	Toronto	734	991.
McPhail, J.	S. S. Marie	976	
McRae, P. J.	Detour, Mich	820	
McTomney, P	Michipicoton Harbor	829	1,036, 1,126.
Mackey, J. E	Wawa	928	844, 846, *1,143.
Madge, P.	Thames Road	749	
Malcolm, W	Michipicoton River	803	834.
Martin, H. G.	Wawa	924	720, 768, 778, 929, 972, 1,091, 1,095, 1,148.
Maxwell, C. F	St. Thomas	932	1,115.
May, E	Michipicoton River	789	957.
Merrick, W. C	Cleveland, O	892	792.
Michael, G.	S. S. Marie	850	

List of Licensees.—*Continued.*

Name	Residence.	No. License.	Claims.
Michipicoton Dev. Co	Michipicoton River	762	736, 737, 1,141.
Miller. R. J	St. Thomas	931	1,116.
Mitchell, M E	Guelph	815	
Monsarrat, N. S.	Cleveland, O	891	791.
Morrison, A. M..........	Duluth, Minn	727	
Morrison, E	Michipicoton River	808	919, 1,034.
Murphy. J..............	White River............	760	1,069.
Murray. I	Duluth	739	
Murray. N. H	Duluth	738	
Murray, T. H.	Michipicoton River	783	717, 735.
Murray, W P	Cleveland, O	886	795.
Nelson, J. D............	Michipicoton Harbor ...	765	761, 1,059, 1,125, 1,136.
Nierling, J. J	Jamestown, N. D	981	
Nissen, P. N	Michipicoton Harbor ...	780	825, 835, 836, 1,127, 1,151.
Noel, J.................	Wawa	747	
Osborne, C. S.	S. S. Marie, Mich	939	
Parks, G. F.	S. S. Marie	714	884, 905, 920, 993, 1,027.
Parks, Mrs. A. W........	St. Catharines..........	813	710, 915.
Pattee, G. I	S. S. Marie	936	811, 950, 954, 956, 971, 976, 984.
Patterson, D. C.	S. S. Marie	801	
Pellcy, W	Michipicoton Harbor ...	811	918.
Pellow. H	Chapleau	841	
Perry, F. L	Bridgeport, Conn	753	1,120.
Perry, R. I	Bridgeport, Conn	754	1,121.
Peterson, O	Duluth, Minn	743	
Pettit R	S. S. Marie	912	1,103, 1,106.
Pilkey, R..............	S. S. Marie	964	726,749,755,760,914,1,055,1,065.
Pinze, A................	Riviere Ouelle, Que.....	883	1,087.
Pinze, J	Missanabie	798	
Pokorney, L. G..........	Huntsville	872	1,076.
Pol, B..................	Bangor, Me............	949	723, 771, 948, 952, 978, 1,042.
Pol, Josephine	Bangor, Me............	968	719, 773, 1,0?2, 1,096.
Pononish, A	White River............	715	830.
Preneveau, G............	Missanabie	796	1,124.
Quarters, N.............	Marquette, Mich........	731	785.
Ralph, M...............	Duluth, Minn	822	787.
Rankin, E	Marquette, Mich........	746	784.
Rathburn, R. H.	Duluth, Minn	724	
Reed, G	Michipicoton River	941	839, 1,089.
Roaf, J. R..............	Michipicoton Harbor ...	861	994.
Rogers, G. H............	Ottawa	946	880, 1,129.
Roth, F	Cleveland, O	955	999, 1,000, 1,001.
Rush, R................	Echo Bay..............	734	
Sage, M	Michipicoton Harbor....	799	1,066, 1,135.
Saults, Mrs. W. W.......	Goderich	816	711.
Sayer, J	Garden River	907	
Schafer, E. J............	Michipicoton River	940	1,139, 1,140.
Schelin, C	Duluth, Minn	726	
Schelin, G	Duluth, Minn	726	
Schoennmann, G	St. Louis, Mo	911	1,090.
Seymour, W. L..........	Chicago....	888	789.
Shannon, C. E	Duluth, Minn	723	
Seneca Gold Co., Ltd.....	Welland	836	
Shannon, R. P...........	Duluth, Minn	722	
Shaw, A. W	Michipicoton Harbor ...	774	
Sheppard, A. A..........	S. S. Marie	975	
Shipley, H. F.	Michipicoton Harbor ...	860	1,149.

LIST OF LICENSEES.—*Concluded.*

Name.	Residence.	No. License.	Claims.
Simmons, N	Michipicoton River	835	733.
Simpson, C. M	Duluth, Minn	742	
Simpson, N	S. S. Marie	974	902, 929, 938, 1,134.
Sjostedt, E. A	S. S. Marie	847	808, 862.
Smart, T. K	Wawa	752	732.
Smith, G. O.	Duluth, Minn	759	
Smith, R. H	Michipicoton Harbor	812	886, 903, 1,024, 1,032, 1,037.
Smith, W. O	Duluth, Minn	758	
Specht, A. M	Duluth, Minn	756	
Spencer, Dr	Brantford	922	799, 1,158, 1,159.
Stewart, M	Duluth, Minn	918	
Stone, R	S. S. Marie	963	727,748,756,758,913,1,054,1,062.
Stowell, W. A.	Pleasantville, Pa	899	1,113.
Stribling, F. W	S. S. Marie	763	897.
Struthers, W	Michipicoton Harbor	766	1,060, 1,131, 1.133.
Sutherland, J. G	S. S. Marie	960	812 887, 899, 933, 1,021, 1,030.
Swick, J	Michipicoton River	904	1,082.
Swift, P. H.	Rice Lake, Minn	750	
Talbot, H. E	Dayton, O	898	722, 974, 982, 1,093, 1,097.
Talbot, K. H	Dayton, O	921	975, 983.
Teare, J. H	S. S. Marie	906	718.
Thibault, N.	S. S. Marie	784	765, 798.
Thompson, C	Michipicoton River	823	
Thompson, F	S. S. Marie	965	729, 752, 923.
Thompson, R	S. S. Marie	966	725, 751, 757, 759, 917.
Thomson, C	Duluth	751	
Tobin, jr., F	Marquette	730	992.
Towers, T. A. P.	S. S. Marie	920	
Trembley, C	Michipicoton Harbor	880	
Trembley, J	Michipicoton Harbor	925	767.
Van Evera, J. R	Marquette, Mich	893	793.
Vansickle, W. B	Lynden	833	
Wallace, J	Michipicoton River	832	837
Ward, L. M	Pleasantville, Pa	916	712, 961, 1,049.
Ward, Myrtle	Pleasantville, Pa	930	1,111, 1,112.
Ward, Venia A	Pleasantville, Pa	818	1,045, 1,046, 1,074.
Ward, W	Pleasantville, Pa	788	713, 962, 1,044.
Warren, S	S. S. Marie	962	890, 904, 926, 980, 1,019, 1,029.
Wheeler, C. P	Chicago	887	788.
Wilde, J. A	S. S. Marie	848	806, 815, 818.
Wiley, A. M	Port Arthur	773	
Wiley, F. S.	Port Arthur	870	851, 854, 855.
Wiley, H. A	Port Arthur	869	853, 856.
Willmott, A. B	S. S. Marie	800	1,150, 1,153.
Wilson, W. J	S. S. Marie	900	
Woodburn, A	Michipicoton River	716	782, 864, 865, 871.
Woodburn, A. S	Ottawa	873	1,078, 1,080.
Woodburn, H. P	Ottawa	825	1,079.
Woodburn, J	Ottawa	717	731, 866, 867, 1,077.
Worthington, C. P	S. S. Marie	967	728, 750, 753, 1,056, 1,064, 1,067.
Younkin, F	Jackson, Mich	917	

Victoria Mines : Aerial Cableway over Roast Beds.

 Victoria Mines Aerial Cableway to Roast Beds and Works.

Bruce Copper Mines: Concentrating Mill.

Rock Lake Mining Company: Concentrating Mill.

MINING LAND AGENCIES.

Local agencies for receiving applications for mining lands, the supplying of information to prospectors and others, and generally facilitating the transaction of business between the public at a distance and the Department at Toronto, are in existence at Rat Portage, Massey Station and Sudbury. District and township maps are kept at these agencies for free consultation, as well as books of record which show whether or not any land about which inquiry may be made has been granted by the Crown or not. Copies of the mining laws and regulations, reports of the Bureau of Mines, blank forms of affidavit and application for lands, etc., are furnished by the agents in charge to those requiring them, who also receive and remit to the Department moneys on account of mining lands, and in many other ways render useful service to the mining public.

The agency at Rat Portage was established in 1897, Mr. Elihu Stewart being the first agent. On Mr. Stewart's appointment as Inspector of Forestry under the Dominion Government, and consequent resignation of the position of mining lands agent, Mr. L. C. Charlesworth was appointed his successor. The Massey Station and Sudbury agencies were opened in the summer of 1900, the Crown Lands agents at these places, Messrs. D. M. Brodie and T. J. Ryan respectively, being charged with the duties in addition to their regular work. As will be seen by the reports appended, the agencies are a decided convenience to the people of the localities in which they are situated.

Rat Portage Agency.

Mr. L. C. Charlesworth reports: I beg to present the following short account of the business transacted at the Mining Lands agency at Rat Portage during the year 1900.

The Rat Portage agency since its establishment in 1897 has continued to occupy the same office in the Scovil block on Main street. During the year 1899 there was a great increase in the amount of work done over the two previous years, but owing to various causes both general and local, this increase was not sustained during 1900.

The low water which prevailed in the Lake of the Woods all through the past summer, and which practically paralyzed the large lumber industry here for the time being, affected business generally in Rat Portage very seriously, and the taking up of mining lands was of course considerably diminished owing to the fact that among prospectors and those in the habit of "grub staking" them, money was scarcer than usual. Notwithstanding this fact the amount of business transacted through this office compares favorably with that done in 1897 and 1898, although as previously stated it is less than that done in 1899.

The number of applications for land registered here during 1900 was 260, as compared with 475 in 1899, and 394 in 1898, and the amount of money forwarded from this office to Toronto was $7,221.73, as compared with $8,856.93 in 1898, and $5,932.57 in 1897. The amount forwarded in 1899 was $14,721.69. In addition to these applications, there were 467 communications received from parties desiring information about lands in the district, and information was continually given to verbal inquirers.

A discoverer on making inquiry here can immediately ascertain whether the land he desires to take up is open for purchase or is already taken up, thereby saving much time and frequently much trouble, and capitalists coming here for the purpose of examining and purchasing locations can ascertain at once the condition of any location offered them. The establishment of the office has also largely done away with disputes in regard to mining locations, and is accordingly a great benefit to all interested in mining in the district.

During the year 1899 a new map of the Lake of the Woods district was prepared here and published by the Department of Crown Lands. This map, utilizing the information afforded by

the latest surveys and thereby correcting errors in previous maps, was a great aid tc the work here, and the free distribution of the maps by the Department to all interested in mining was much appreciated by the public.

The chief interest in this district last season centered in the region east and northeast of Whitefish bay of Lake of the Woods, in the vicinity of Sturgeon and Deer lakes. The greater part of the prospecting last season was done here, and there was an active demand for maps of the region. There has been up till now none published, but I am preparing one from what information I can gather, and although owing to lack of full information it is impossible to compile a correct map still it will be of considerable use to prospectors.

Eagle lake also attracted considerable attention, and it is in this vicinity and in the country southwest from Eagle lake to Deer and Sturgeon lakes, that I expect most of the prospecting will be done next season.

During 1899 the Department of Crown Lands set aside a tract of country lying north of the C. P. Ry. and east of the west boundary of the Province of Ontario, in which a licensed prospector could stake out his own claim under certain regulations, and could register the same here. So far there have been no claims staked under these regulations the prospector preferring to have his location surveyed and take out a lease or patent of the same.

Massey Station Agency.

Mr. D. M. Brodie reports : I take the liberty of submitting herewith a brief report of the workings of this mining agency since its inauguration. It was established on or about the first day of August last and considerable time elapsed before the public in general became acquainted with the fact.

The agency is open from 9. a. m. till 5 p. m. and the agent being in possession of a record book called the "Land Roll" supplied by the Department showing all lands patented and leases issued, is at once able to inform inquirers as to the validity of their applications, and thus prevent applications being made to the Department of Crown Lands covering properties which had been previously sold or leased, in many instances also avoiding unnecessary delay by having to write to Toronto to procure information that can be and is now supplied at once free of charge by the mining agent at the local office.

At the end of each month a schedule is received by me from the Department showing all lands and leases sold or that may have been patented during the month within the limits of the agency.

Applications are frequently made direct to the Department and not through the local agent; this course has been the cause of some little complaint by several prospectors and others engaged in mining who contended that all applications should pass through the local office. While such a regulation in my opinion would be feasible within a short radius of the local office, it must be taken into consideration that the ground covered by the agency extends many miles both east and west, and covers considerable territory, and that it would be unjust and expensive were all parties compelled to appear in person at the local office to present their applications or make affidavits for same.

The difficulty could be remedied and very little delay occasioned by requiring applicants to mail their applications to the local agent, who could record same and at once mail them to the Department for approval. The instances in which applications are thus duplicated by individuals are so few that in my opinion little or no complaint should be heard from this source.

All necessary forms for applicants, and copies of the Mines Act are kept on file at the office for distribution, and all applicants are assisted in preparing their applications and putting them in proper form. The public generally have taken advantage of the facilities afforded, as many

inquirers have received information and numerous questions been answered. Maps of all the townships within the limits of the Agency are on file in the office and prove a great boon to prospectors.

I have also on hand sample ore envelopes for the mailing of ore for assaying purposes which are distributed to prospectors free of charge and are supplied by the Provincial Assay Office at Belleville, also schedule of charges for assaying which is posted up in the office, so that prospectors in making applications for mining lands can at the same time if they so desire mail their ore samples to the Assay Office for analysis, thus saving them much trouble and inconvenience.

Samples of the different mineral ores to be found within the limits of the agency are on exhibition at the office, which prove to be of much interest to intending prospectors and inquirers who have been drawn to the district by samples and reports of the mining development which has been attained within the last two years.

Owing to the lateness of the year before the establishment of the agency, not many applications have been received, and the number hereinafter set forth is no indication that the office has not been made use of by the public generally.

Communications have been received from the United States and Great Britain asking for information and requesting samples of ore from the district which were duly supplied.

It must also be taken into consideration that the mining industry west of Worthington is practically in its infancy ; and I might add that it was only since an exhibit was made at the Toronto Industrial Exhibition in the summer of 1899 of copper ores from this vicinity that increased interest has been shown by many who have expressed their surprise at the number and magnitude of the deposits. It is my intention from the beginning of 1901 to keep in addition to the present books a " Register " and have all callers and inquirers record their names and addresses therein, so that prospectors can at once ascertain the addresses of those who are desirous of purchasing claims for development.

During the year ending December 1900, the mining applications sent from this office numbered twenty-three and the amount of money remitted to the Department for leases and rentals was $293. I look forward to the coming year being one of more activity than the present has been, and am of the opinion that good results will accrue from the establishing of the local offices.

Sudbury Agency.

Mr. T. J. Ryan reports :—I beg to report on the operations of the Mining Agency at Sudbury as follows : The office was established and opened on the second day of August, 1900, for the transaction of business. A suitable set of books, maps and forms, together with the mining regulations, were furnished by the Bureau of Mines. Twenty-nine townships were placed on the land roll for mining purposes.

There was an average personal attendance of mining men and prospectors of about 60 per month, and in addition there were many who used the office by corresponding. The great majority came for information or blank forms or mining laws and maps and reports of Bureau of Mines.

The book that gave great satisfaction to people seeking information was the Land Roll. This book has met with general approval. Men who come to see about a particular lot desire to examine the roll, get their information quietly, and leave to look after the claim if not marked sold. They would very much like if a list were sent the agency each month or oftener of all applicants for lots, as well as the customary list of names of purchasers and lots actually sold or leased, also that several other townships be added to the agency. The fact that

applicants can, after getting necessary information, go to their solicitor or any person empowered to administer oaths to have their mining papers prepared and sent direct with money to the Department, has the effect of preventing the agency from earning any fees worth speaking of.

The agency is really a bureau of information and for the distribution of mining forms, Mines Acts, etc. In this respect it is well patronized and very popular. The sum of $300 was remitted to the Department by the agency. This could have been largely increased but for the fact that the Department had to refuse to sell some well-timbered lands applied for until such time as the timber licensee could remove the pine. About 2,000 acres of land was applied for through the agency from the time it was opened until the end of 1900.

PROVINCIAL ASSAY OFFICE, BELLEVILLE.

Mr. J. Walter Wells, B. Sc., in charge of the Assay Office at Belleville, reports on the year 1900, as follows :

This office was opened July, 1898, by the Bureau of Mines as an experiment to see what effect it might have in encouraging prospecting and development of mineral lands in Ontario. The office offers to prospectors and owners of mineral lands an opportunity of securing reliable assays at a nominal cost, the fees charged being only intended to prevent abuse of the privileges.

That prospectors appreciate the value of a public assay laboratory may be judged from the following yearly record of determinations :

	1898 (6 mos.)	1899.	1900.
Assays and Analyses	406	1,651	2,215
Identifications and Qualitative Examinations	45	304	187

The office is located in Belleville under agreement with the city council by which the latter undertakes to provide suitable quarters. It accordingly occupies two flats, No. 24 Victoria Ave., the ground floor being divided into (1) office, (2) sample room for storing pulp and rough ore samples, (3) crushing and store-room containing crushing machinery and laboratory supplies. The second flat is divided into (1) analytical room, (2) assay room, (3) balance room. An outhouse is used for storing gasoline underground.

Functions of the Office.

The office has performed the following services for the Bureau of Mines during the year :—

Laboratory assays and analyses of samples sent in by Government geologists and survey parties exploring the unsurveyed portions of northern and western Ontario, and assays of samples forwarded by private parties through the head office.

Check analyses of iron ores upon which it is proposed by the miners thereof to claim the bounty provided by the Iron Mining Fund.

General laboratory work for report on Peat Industry in Ontario, giving analyses and calorific power of various raw and briquetted peats.

Progress has also been made on a report intended to cover the Arsenic Industry ot Eastern Ontario.

The following services for the mining public have been performed during the year:

Issuing laboratory reports consisting of assays, analyses, qualitative examinations, identifications or reports as to probable commercial value of minerals. These reports are charged for at actual cost according to the scale of fees approved by the Director of the Bureau of Mines and are entirely the property of parties paying the fees for tests ordered.

Acting as an information agency, answering as far as possible, inquiries from owners of mineral lands as to market prices, uses and purchasers of minerals. Inquiries from dealers, investors and manufacturers using minerals asking information regarding Ontario's ores are published in the monthly office bulletin.

Making check or umpire determinations in case of disputes as to correct values. In most cases differences were found to be due to different methods of sampling rather than to errors on the part of the assayer or chemist.

Issuing free of charge a monthly official bulletin containing laboratory report, inquiries and items of general interest. This is reproduced in whole or part by newspapers in Ontario and mining journals in Canada, United States and Great Britain.

Samples of common economic minerals are distributed to bona fide prospectors who may be in doubt as to the characteristics of certain ores. Shipping bags are supplied for heavy samples and mailing envelopes for small and crushed samples.

Laboratory Determinations.

The following tabular statement shows the laboratory determinations in detail made during the year, each being checked off by a duplicate before issuing certificates to avoid errors.

Mineral.	For the Bureau.	For the Public.	Total.
Assays.			
Gold—fire assay	124	694	818
Gold—amalgamation assay	6	5	11
Silver—fire assay	130	313	443
Copper	29	157	186
Nickel	28	71	99
Platinum	18	7	25
Zinc	3	12	15
Manganese	4	1	5
Tin	2	0	2
Cobalt	14	6	20
Lead	13	4	17
Totals	371	1,270	1,641
Analyses.			
Silica	9	23	32
Sulphur	41	39	80
Phosphorus	28	11	39
Titanium	15	24	39
Metallic iron	43	106	149
Moisture	25	8	33
Miscellaneous	78	5	83
Volatile combustible	23	2	25
Fixed carbon	24	6	30
Ash	24	6	30
Alumina	3	8	11
Ferric oxide	2	6	8
Arsenic	1	4	5
Lime	3	5	8
Magnesia	2	0	2
Totals	321	253	574

Total number of samples received for assay	1,111
" " " identification, etc.	187
Total	1,298

Total assays	1,641
" analytical determinations	574
" identifications and qualitative examinations	187
Total determinations	2,402

The laboratory is equipped for the following determinations :—

Gold and Silver : (1) By fire assay, using a set of gas furnaces and Hoskin's muffle furnace burning gasoline. The lead balance for weighing buttons, made by Smith & Thompson, Denver, Colo., style 18, is sensitive to $\frac{1}{100}$ milligram, giving gold values to 20 cents per ton of ore, (2) By amalgamation assay using arrastra which is being replaced by bottle-amalgamation outfit.

Copper : By electrolytic and cyanide titration methods, the latter on pure copper ores.

Nickel ; By Merry cyanide titration method.

Lead : By fire assay for rich ores, and molybdate titration for lean ores.

Zinc : By ferro-cyanide titration method.

Platinum : By fire assay.

Manganese : By Bolbard's titration method for rich ores.

Metallic iron : By bichromate and permanganate titration methods with stannous chloride as reductor.

Sulphur : By weighing as barium sulphate in iron ores.

Phosphorus : By precipitation with molybdate, then titration with potassium permanganate using metallic zinc as reductor.

Titanium : Weighing as titanium dioxide.

Lime : Titration with potassium permanganate for limestones and marls ; weighing as oxide in rock analysis.

Other determinations are by standard methods. All determinations except those requiring an impalpable powder are made on pulped samples at 100-mesh, duplicates of which in each case are retained for future reference. The analytical balance reading to $\frac{1}{10}$ milligram is being replaced by a more sensitive Sartorius balance. Two laboratory assistants are employed. Messrs. C. F. Nicholson, C. W. Dickson, G. H. Dickson, students from the School of Mining, Kingston, acted as first assistants during the year, each obtaining more responsible and better paid positions after a few months' laboratory practice. Laboratory fees aggregating $1,378.15 were collected during the year. While the fees are nominal, no certificate can be issued before they are paid. No charges are made for qualitative examination or identification on samples brought personally to the office.

THE VERMILION RIVER PLACERS.

BY A. P. COLEMAN.

In accordance with the instructions of Mr. Archibald Blue, former director of the Bureau of Mines, last summer's fieldwork was devoted to a study of the placer deposits of Vermilion river and meteor lake, and of the distribution of the Lower Huronian iron ranges in the Province of Ontario.

Mr. G.F. Kay, B.A. was appointed assistant and proved energetic and efficient. The placers were examined first, an excursion being made up the Vermilion river and another to Meteor lake and the territory between the two points, following up most of the known auriferous gravels. Attention was then given to the iron ranges, to the north and west, a report on which will be found elsewhere.

Before and after the main field work in the northern and western parts of Ontario some time was spent in working out the marine and fresh water beaches of eastern Ontario and a report on these deposits is also included in the present volume.

As usual, much aid and hospitality was received from mining men and others interested in the mineral resources of the country, but special thanks are due to the officers of some of the placer mining companies which have been opening up the Vermilion and Meteor lake regions.

Fine Gold in River Gravel.

The placer deposits of Vermilion river were examined and reported upon for the Bureau of Mines in 1897 by Mr. Arthur H. Gracey,[1] who entered the region from lake Wahnapitae, ascended Vermilion river to its head, and returned by lake Onaping. As a good deal of prospecting had been done since that time and the gold-bearing gravels had been found to extend much farther north with promising prospects in the neighborhood of Meteor lake, a more extensive study of the region was called for, and I was instructed to go over the ground.

Leaving Sudbury by team on May 18 the Vermilion river, at "Dawson city," as an old lumber camp on its shore has been euphemistically called, was reached the same evening. The road is good as far as settlements extend and afterwards old lumber roads serve the purpose fairly well. Dawson city, which is on lot 11, concession VI, of Hanmer, does not include a single habitable house since Hale and Booth's lumber camp has fallen into decay or been burnt. The Great Northern Mining Company has 320 acres secured in the neighborhood and has done a small amount of prospecting work in the form of test pits, sluicing, etc. Here some time was spent in examining the gravels and panning. The gravel beds occur on both sides of the river, but are most extensive in the direction of Marshy lake to the east. Near the river the gravel is exposed on its banks for a depth of 17 feet and in a number of small test pits, the deepest of which going down 20 feet, has been timbered ; however, as the work was done two years ago the materials have in most cases run down and prevent a very satisfactory examination. The gravel is fairly well rounded and consists of quartzite, granite, green Huronian rocks and a few small flat pebbles of red or purplish slate, the latter said to accompany gold. There are some boulders, but few were to be seen more than a foot in diameter ; and there is often some loam or clay mixed with the gravel.

Colors were found in every pan, sometimes to the number of 40 or more and in one case reaching 100, but very fine, many of them barely visible to the naked eye, so that care had to be taken to keep them in the pan when washing. There was much garnet with the black sand

[1] Bur. Mines, Ont., Vol. VII., 1897, pp. 256-259, with map.

at the bottom of the pan, as a rule. Near Marshy lake, an expansion of the Vermilion, there are other test pits, some of them 30 feet above the water, all yielding colors in the pan, and it is stated that panning shows colors of gold almost everywhere in the gravels near the river and lake over an area of several square miles.

The only rock observed in place is the dark volcanic ash or breccia mapped by Dr. Bell as probably Cambrian in age ; but there is little doubt that the gold has come from the destruction of the Huronian rocks to the north whose pebbles make the bulk of the gravel.

A western placer miner named Anderson, employed to explore the property by test pits and rockers or sluices, is said to have obtained only three cents of gold per cubic yard of gravel, but his methods are supposed to have been suited to somewhat coarse gold rather than the exceedingly fine gold of the Vermilion. Numerous assays of gravel from here made by Mr. Evans of Sudbury yielded from 50 cents to $1.15 per ton, 20 samples taken from beneath the snow averaging 85 cents per ton. The best pan washed by myself on a second visit to the property contained 62 colors.

A sample taken from the same place was sent to the Provincial Assay Office, Belleville, for assay ; and Mr. Wells reports that 11 lbs. 3 ozs. of sand and clay finer than 2-mesh yielded $2.60 per ton ; 16 ozs. of clay and sand cleaned from pebbles larger than 2-mesh gave $3.60 per ton. The pebbles weighed 9 lbs. 3 ozs. and gave $0.80 per ton. The gold obtained from the pebbles could not, of course, be extracted by placer methods ; so that the available gold is that obtained from the finer materials. The yield for these two portions if distributed over the whole amount of the sample, 21 lbs. 6 ozs., gives a value of about $1.50 per ton. This includes the whole of the very fine gold, part of which would probably be lost by any ordinary process of placer mining. It must be understood of course that this was not an average sample of the gravel but was taken from the richest test pit from which material was obtained for panning, and that the gravel must average much below the amount mentioned. To get a true average from the large extent of auriferous gravel on the lower Vermilion would require a greater amount of work than we could devote to it, and it was thought unfair to the owners of the property to have assays made of the poorer ground, since, no doubt, the best parts of the gravel would be selected for treatment in case the ground were worked.

THE GREAT NORTHERN COMPANY'S CLAIMS.

The Great Northern Mining Company claims lot 1, con. VI. and the north half of lot 1, con. V., in Hanmer, lots 10, 11 and 12 on con. VI. of the township of Capreol, with the north halves of lots 11 and 12 on con. V. of the same township. Their manager, Mr. Norman Stewart Jenkins, and his son, have claims on several other lots in the vicinity, and state that gold has been found on all the lots referred to. Mr. Jenkins, who accompanied the writer in his visit to the region, gave much assistance as guide to the various test pits on the company's claims. The first gold is said to have been panned here by a chore boy in the lumber camp seven years ago. Mr. Jenkins first obtained gold here in November, 1897, and in the following summer came the rush to the region which was the occasion for Mr. Gracey's visit.

Going north up the Vermilion the river valley narrows, rocky hills partly of Huronian and partly of Laurentian rock hemming it in, so that there is no great width of gravel, though more gravel is found beyond the hills in a parallel valley a mile to the east. The river is rapid and one must pole or track up it much of the way until a portage becomes necessary north of Bronson lake at a rapid having a fall of about fifteen feet (aneroid). Near this point a belt of diabase or gabbro, in some places charged with pyrrhotite, has been taken up as nickel land. The belt is rather narrow here, but is on the line of the northern range of nickel properties, reaching from Morgan township to the western end of lake Wahnapitae. Some green schist accompanies the diabase or gabbro.

A gravel terrace rises 15 or 20 feet above the river on the east side where a creek enters it just below the rapid, and panning showed a few colors. Gold is found in sand and gravel half a mile up the creek also, but the results were not encouraging, though Henry Ranger, a well known prospector of the region, reports very good pannings from the same point.

CLAIMS ON ROSS LAKE.

On Ross lake a number of claims have been located and some work in the way of test pits, etc., has been done, especially near Gordon's camp, and the gravel terraces are much wider than on the river below, though rocky hills bound the valley here also. Just east of the camp against a hill of granitoid gneiss with angular and contorted inclusions of gray schist there are two terraces, one rising about 35 and another 57 feet above Ross lake ; and a little to the south on the lower terrace there is a small lake which could be drained by a ditch running a couple of hundred yards to the river. Apparently an attempt has been made to arrange for sluicing here, for the timber has been cut and a commencement made at the ditch. A small amount of work has been done nearer camp, a wheel having been built for lifting water from a swampy creek near by for the purposes of sluicing. The gravel from pits sunk here is said to have been rich, and we found as many as 40 colors to the pan. A sample pan of gravel from here was sent to Mr. Wells for assay with the following results :

12 lbs. 8 ozs. of clay and sand finer than 2-mesh	$1.80 per ton.
14 ozs. of clay and sand washed from pebbles	1.20 per ton.
7 lbs. 3 ozs. of pebbles	trace.

As the whole weight was 19 lbs. 1 oz. the average per ton is about $1.25. It should be stated however that there were many large boulders in the gravel, making up not far from half of the material, so that the true value per ton must be considerably less than this, perhaps not more than half.

To the east of the opening at the water wheel there is a rounded gravel ridge rising about 120 feet above the lake, and to the east of this, rock can be seen rising as small ridges and finally as hills. It is evident that in some places here bed rock could be reached without sinking to any great depth.

On the western shore of Ross lake locations have been taken up, by the Rangers and others, who have sunk a number of test pits, one to a depth of 18 feet without reaching bed rock. The gravel goes down 12 feet and shows colors of gold, but below that is whitish gray sand with few colors. At another pit they found 4 feet of gravel with colors, then 6 feet of coarse sand without colors, and below this once more gravel with colors. Some ridges of gneiss along the river and a few points of rock within the gravel flat, one a boss of diabase, as well as a lofty hill of granite west of the valley, show that bed rock should not be very hard to reach if it were not for the coming in of water. Most of the gravel here is finer than on the other side of Ross lake, and few boulders were seen that would cause trouble in working with a dredge. Some of the pebbles are of jasper.

Colors were obtained along with black sand in most of the pans and a sample taken from claim 72 sent to Belleville for assay gave the following results :

8 lbs. 2 oz. of sand and clay finer than 5-mesh	$3.20
23 ozs. of pebbles and clay between 2- and 5-mesh	2.60
3 lbs. 6 oz. pebbles over 2-mesh............................	1.20

Omitting the pebbles the average gold contents of the 12 lbs. 15 ozs. would be about $2.30.

Another sample from an adjoining claim (71) gave about 85 cents per ton omitting that contained in the washed pebbles which amounted to 80 cents per ton, but of course could not be

extracted without milling. Probably the second sample comes nearer the average than the first.

On the west side of the Rangers' claims there appears to be an old channel of the river, a series of small lakes occupying a depression where the gravel approaches the rocky hills. The whole width of gravel here is probably not more than a mile.

At the southeast side of Ross lake a hill of granitoid gneiss with masses of gray-green schist and dikes of coarse reddish granite interrupts the gravel plain, but beyond it toward the east there is another valley containing several lakes in a gravel deposit said to extend south to Marshy lake. It is thought by prospectors that this is an old river valley.

As not much work had been done above Ross lake and the gravel deposits higher up had been visited by Mr. Gracey, the next few miles of bad river were avoided, our canoe being large and heavy for the flat rapids, and returning to Sudbury a fresh start was made for Meteor lake.

Route to Meteor Lake.

We started in with canoes at Geneva lake, where Huronian quartzite often filled with pebbles of all sizes up to three feet in diameter attracts attention near the station.[2] From this we portaged three-quarters of a mile to a second smaller body of water, lake Bannerman, where gravel terraces said to contain little or no gold rise 40 or 50 feet against hills consisting partly of Laurentian gneiss and partly of slate conglomerate and diabase. After a short distance on Bannerman creek a lumber road leads northeast toward Onaping lake.

The region has been burnt for the second time along most of the road and in places the hills are absolutely bare and very rugged, the valleys being more or less filled with boulders. Some large rocks perched on the hill tops give evidence of glacial action. The rocks in place are Huronian. Two and a half miles up the creek from the railway we loaded our canoes which had been brought up empty, and ascended a few miles, then turning off to a chain of small lakes on the east to avoid a bad part of the creek. Returning to the creek about three miles brings one to the foot of lower lake Onaping where a dam has been erected for lumbering purposes. Jasper conglomerate boulders occur near by and are referred to elsewhere in discussing the jasper iron ores. At the narrows between lower and upper Onaping lakes and also five miles above the dam similar rocks were observed in place. Thus far the formations have been represented on Dr. Bell's map of the Algoma and Nipissing districts ; but beyond this the rough map available is much less accurate.

Laurentian rocks follow with some darker gray inclusions suggesting Huronian contact, and also a few dikes of diabase. Where the canoe route turns off to the east into a bay leading toward Long lake we find only Laurentian, partly schistose and partly massive looking, a small island just at the turn being syenite.

ON THE UPPER WAHNAPITAE

Leaving the eastern bay of lake Onaping after a short portage a lake about a mile in length is traversed, after which comes a longer portage into Long or Ten Mile lake, part of the Wahnapitae system of waters. Long lake is struck about midway in its length and is followed northwards into Wahnapitae river. After a short portage one runs down the river to a small unnamed lake from which there is a portage into another small lake and then into Shoo Fly lake, both having clear water instead of the usual brownish colored water, and both enclosed largely in gravel plains where some gold is found. The short portage into Shoo Fly lake climbs a gravel ridge 38 feet high and then descends again 17 or 18 feet to the level of the latter lake, so that there is really a fall of 20 feet from Shoo Fly to the lake preceding it. The gravel banks

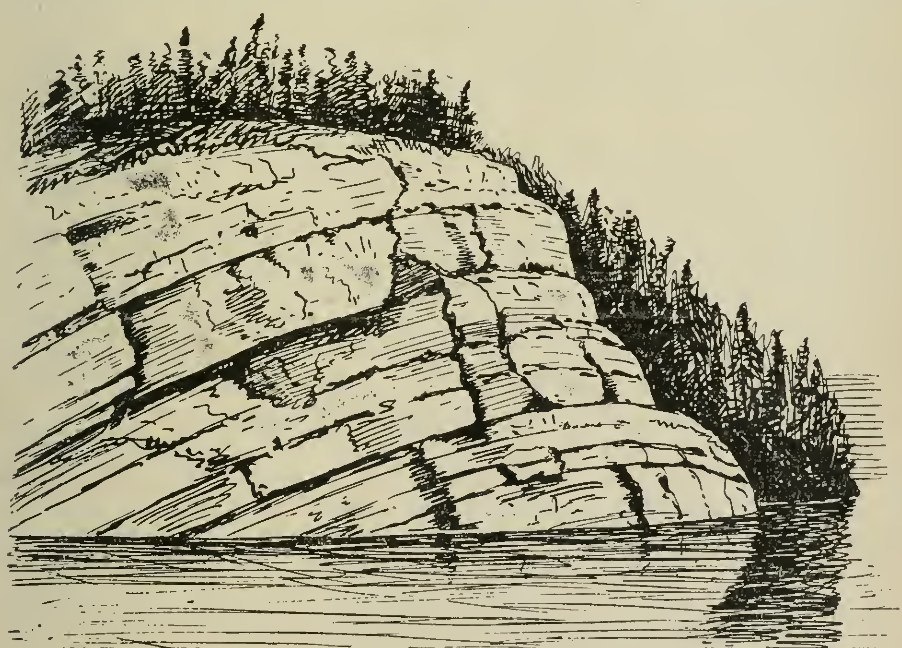
[2] Cf. Dr. Bell, Geol. Sur. Can., 1890-91. p. 38, etc., F.

must be somewhat cemented or charged with clay to allow the two lakes so different a level. While Ten Mile lake had high cliffs of granite, the shores of the following lakes show little or no solid rock but are almost entirely in gravel plains which have been taken up as placer mining claims.

Shoo Fly lake runs about four miles north, when a short portage is made to a pond, then a portage of more than a mile brings one to three successive ponds separated by short portages. Finally a portage of less than a mile is made into Meteor lake, on whose shores the only development work of importance has been carried out. In order to connect as far as possible with the series of placers on the Vermilion an excursion was made to Post lake, where Mr. Gracey found coarser gold than farther down the Vermilion, the route followed being down the same series of ponds and lakes to Shoo Fly lake, whence a portage takes one into Oshawong lake, an expansion of the Wahnapitae. Here not much gravel is to be seen and cliffs of reddish Huronian quartzite with some bands of green slaty rock rise on the east side; but the short portage to Wigwam lake toward the southeast is over a flat gravel plain, though the lake itself has low boggy shores. Terraces on the southwest side of Wigwam lake are said to consist of gravel covered with sand; the former showing a few colors.

Head Waters of the Vermilion.

A portage of three-fourths of a mile leading over sandy plains with one steep ridge of sand crossing from east to west, allows one to pass from the Wahnapitae waters to the first of the Vermilion chain of waters, a pond having a stagnant outlet into Blue lake. All the region west of Oshawong, Wigwam and the north end of Blue lakes as far as the Wahnapitae river at its north



Anticlinal Fold of Upper Huronian, Blue Lake.

ward bend has been taken up as placer claims. Blue lake, which runs somewhat west of north and east of south, is about 5½ miles long and has mainly rocky shores, often precipitous, with no important beds of sand or gravel. All the north end is Huronian, mostly greenish slate with purplish streaks of quartzite, apparently cut by dikes of flesh-colored felsite or microgranite.

Near the head of the lake the slate strikes about east and west and dips 80 degrees to the south ; but lower down the gray slate has a strike nearly north and south. Still lower the slate, now interbedded with fine-grained reddish quartzite, has a strike of about 120 degrees and dip of 45 degrees to the northeast. At a narrows half way down the lake cliffs of reddish quartzite rise 140 feet on the east side and almost as high on the west, with only a narrow channel between ; and here one finds the thickly bedded rock bent into a rather gentle anticline, the dip being to the northwest on the one side and the southeast on the other. From the top of the promontory one sees plains of sand and gravel to the west of Blue lake and beyond them rocky hills, apparently of the same quartzite.

From the south end of Blue lake a short portage gives access to a pond with gravel shores and apparently no outlet, from which another portage leads to Henderson lake, thus escaping a shallow flat rapid on Vermilion river. The upper end of Henderson lake is enclosed by gravel terraces, but hills of fine-grained diabase rise on the eastern side of the lower end. Some panning was done at various points where test pits had been sunk or on the shore, especially at gravel ridge 75 feet high, but the results on the whole were not favorable, the largest number of colors being 9, and most of them very minute. Part of the shore of this lake has been burnt, spoiling its appearance as compared with the wooded shores of most lakes in the region.

A mile below Henderson lake is Post lake, where we found Indians encamped ; but could get little information from them in regard to workings in the region, though they pointed out to us the old Hudson bay route westward towards Long lake and lake Onaping. In the large area of gravel northwest of this several locations have been made and Mr. Gracey reports comparatively coarse gold.

As the 15 miles of river between this and Fraser lake, the highest point visited by us coming up the Vermilion from Dawson, is difficult to navigate in low water and the gravel deposits are reported like those described, but with less development in the way of test pits, we turned back to Meteor lake.

Workings on Meteor Lake.

From the head of Blue lake to the head of Shoo Fly lake, a distance of about 7 miles, the whole region has been taken up as claims. Two and a half miles north of Shoo Fly lake the claims about Meteor lake begin, reaching as far as the portage to Seven Mile lake, a length of three and a half miles in a northwesterly direction. As the only serious attempt to settle the value of the placers has been made on Meteor lake however, this region will be taken up at greater length than the others. Most of the shores of the lake are of gravel, but granite forms an islet and rises a few feet above water beneath the gravel on the peninsula south of the camp. The lake which is said to drain into the Wahnapitae, is narrow and somewhat cut up with islands and bays, and has fairly wooded shores including a considerable amount of rather small red pine. The shores are often as steep as gravel will lie and sometimes rise 60 feet above the water, which deepens very rapidly off shore in many places and is reported to be 150 feet deep. The surface of the lake is 1,393 feet above the sea, as shown by aneroid readings, and it stands exactly on the water shed between the waters of the St. Lawrence and those of Hudson bay, all the lakes around it except the ponds to the south being at a lower level, though Onaping, some miles to the west, is 1,417 feet above the sea according to Dr. Bell's determination. While Meteor lake has a visible outlet into the Wahnapitae and thence into Georgian bay, part of its water seems to make its way through a gravel ridge to the north, as pointed out to me by Mr. J. F. Whitson, O.L.S., for the nearest inlet of Seven Mile lake, reached by a portage about 400 feet long over a gravel ridge with a fall of 35 feet, is of clear water, while the rest of that lake is brown.

The gravel on Meteor lake consists, so far as seen, chiefly of Laurentian rocks, though green Huronian schists and eruptives occur and also a few masses of jaspery iron ores. The materials range in coarseness from sand to bouldery gravel, the largest stones reaching a diameter of two or two and a half feet.

ONAPING MINING COMPANY'S LOCATIONS.

The Onaping Gold Mining Company, for which Mr. Stuart Jenkins is manager, has done some thousands of dollars' worth of work in the way of cutting roads on portages between Meteor and Onaping lakes, and in the erection of buildings and introduction of machinery. The camp which stands on the east shore of the lake near its north end, consists of three very fair buildings, an office, a cooking camp and a sleeping camp, with some smaller sheds etc., constructed of boards cut by their own portable sawmill from red pine found in the neighborhood. In addition to the mill which is of 14 horse-power, there are three boilers on the ground, of 8, 18 and 22 horse-power respectively, the larger ones for pumping purposes ; a No. 3 pulsometer pump with 1(0 feet of pipe for keeping shafts dry, and a 50 horse-power pumping engine to provide water for sluicing.

The sluicing plant is set up at the end of the gravel ridge running as a peninsula south of the camp and consists of an engine house with pump, a tank and 11 sluice boxes in succession, each 12 feet long, having a slope in all of 5 or 6 feet. The first two boxes have grizzlies arranged to keep out boulders and larger pebbles, and the remaining 9 have riffles. In working the sluices the larger boulders were removed by hand. It was found that most of the gold was saved in the first four sluice boxes provided with riffles, the other five retaining only very fine gold and black sand. Pannings of material scraped up in the upper boxes, left after the last clean-up, showed much coarser gold than any obtained farther south ; but a pan of stuff from the seventh box gave only black sand and a few fine colors.

The hole from which the gravel was taken is about 13 yards long by 8 wide and perhaps 10 feet deep, though the caving in of the sides makes it hard to determine the exact dimensions. The gravel was hoisted by the team used in bringing in the machinery. The coming in of water from the lake prevented the company from going deeper. The opening is beside a bay running northwards and has to the west the gravel ridge mentioned before, narrow, 50 or 60 feet high, and running for a mile or more, first in a direction about 30 degrees west of north and then bending more to the west between Meteor and Seven Mile lakes. This ridge is probably an esker, though most of the terraces around the lake have the look of lake gravel. At the pit from which the gravel for sluicing was taken there is a terrace 10 or 15 feet high cut into the ridge, very likely by wave action, and a varying thickness of fine sand (one to four feet) overlies a floor of boulders, beneath which is gravel with boulders. Some pans taken from the top of the gravel ridge showed black sand, but very little gold. A pan of the sand just over the gravel in the pit gave 7 colors, one of fair size ; one from just beneath the boulders under the sand gave 22 colors, mostly larger than in the previous pan ; a panful taken 1½ feet lower down in the gravel had 3 small colors and another from a foot lower still had 4 colors, one large. In a general way it has been found that the clayey gravel just under the boulders between the sand and the grave is richer than the gravel below, though a stratum of rich gravel was struck at the bottom of the pit 2 or 3 feet below water level, while the sluices were in operation.

TESTING THE DEPOSITS.

In order to get a better idea of the gold contents of the grave 10 pans of it were put through a rocker giving a number of large colors, one quite angular ; and 20 pans more gave over 50 visible colors, mostly fairly large.

Thirty pans from the upper two feet of gravel in the main pit yielded about 150 colors, several of them large, but a pan of the tailings showed 10 colors, one quite large. As the tailings represent probably half of the whole stuff treated with the rocker, one may suppose that about as many colors were lost as saved, though the ones that went into the tailings may be assumed to be smaller than those saved. The gold dust obtained from the 30 pans in the rocker, when cleaned from black sand weighed 47.1 milligrams, worth about 3⅓ cents. If we suppose that the gold passing into the tailings represented one half of that saved, the contents of the 30 pans, probably 600 to 700 lbs., would be 5 cents, and a ton of the gravel would contain about 15 cents worth of gold, or a cubic yard about 22. It should be understood, however, that the test was a very rough one.

The gold occurs as fine dust, as scales and as small flattened nuggets, the largest obtained weighing 57.2 milligrams, having a value of about four cents ; and the color is good, only one nugget (weighing 20 milligrams) having a pale brassy appearance. It is of interest to note that my assistant, Mr. G. F. Kay, picked out of a panful of gravel a small somewhat angular quartz pebble containing several milligrams of red gold, similar to that found as scales and small nuggets.

One or two other pits sunk by the company on the shores of Meteor lake were visited and found to be more or less gold-bearing, and an excursion was made to two small lakes on the east. Near the second a shaft had been sunk about 20 feet in gravel, said to have contained colors all the way down as tested with the rocker. This shaft was timbered with poles arranged vertically. Much of the shore of the second lake is gneissoid rock with dikes of pegmatite and diabase, but on the north-east end some slaty green rock and felsite occur, suggesting an approach to a Huronian area. No information was gained however as to the source of the placer gold, which may have been brought from a distance by glacial action.

A well timbered shaft was sunk 12 feet on the gravel ridge between Meteor and Seven Mile lakes, showing coarse sand and gravel, and colors were obtained here, but quite small. Much of the shore of Seven Mile lake is of coarse-grained gneiss, and the small gravel patches examined contained only a few colors to the pan.

That a considerable tract of gold-bearing gravel occurs on and near Meteor lake is certain, but how the gold is distributed in the gravel and whether it becomes more concentrated at bed rock is not yet known ; but that the gold is much coarser than any seen along the Vermilion is clear, so that the difficulty in saving it should be much less. Unfortunately no large samples of gravel could be taken for assay to serve for comparison with the gravels farther south, since we had a long and little travelled route with many portages before us in following up the jasper band of Shining Tree lake, and so could not afford to carry weighty specimens.

The kindness of Mr. Jenkins and the Onaping Gold Mining Company in sending with us men familiar with the work done at Meteor lake deserves acknowledgment. The company have shown great enterprise in bringing in teams and machinery from lake Onaping over so many lakes and portages, thus doing much to test the value of the placers of the region.

Extent and Value of the Placers.

Though colors have been obtained by Mr. Jenkins and his men, by Mr. Gracey, Mr. Whitson, Mr. J. D. Taylor and others from gravel deposits near lake Onaping and other points west and north, as well as in the neighborhood of lake Wahnapitae toward the south, it is probable that only the gravels from Meteor lake south southwest to Dawson on Vermilion river deserve attention. With few interruptions these gravel beds extend for 40 miles often having a width of a mile or more and sometimes of two or three miles. At Meteor lake they have an elevation of 1400 feet above the sea, at Ross lake of about 1055 and at Dawson of 940 or more, suggest-

ing the slope of a great river valley, and most of the prospectors of the region believe it to be that. In general however the gravel plains are more like shore deposits in great lakes ; and the fact that there are often several terraces at different levels with no special evidence of river erosion supports this view. The very steep slope of the gravel banks in many of the small lakes, where wave action must be insignificant, and the occurrence of steep-walled lakes without a visible outlet suggest that some of these bodies of water occupy glacial kettles, i.e., basins formed near the edge of a great ice sheet by portions of the ice being buried in shore deposits of sand and gravel and at length thawing, thus leaving basin-shaped cavities. The lakes without apparent outlet have of course a drainage through the loose gravel of their banks.

The ultimate value of these widespread placers is at present very hard to estimate. None of them as far as known are of high enough grade to form a "poor man's diggings." It must be remembered that the assays mentioned of gravels from the Vermilion are not from average samples but from the best observed in the different places ; and also that the fire assay returns give the whole of the gold present, whereas with fine gold such as that of the Vermilion a large percentage could not be recovered by any practicable methods of sluicing.

As to methods of mining, these deposits occur near the height of land and cannot be treated by ordinary hydraulic mining as practised in British Columbia or California, since the requisite head of water is wanting. There is however plenty of water with a fall of 10 to 40 feet, sufficient for sluicing, but whether the gravels will pay by this method has not been tested. The most promising method of mining is the one suggested by Mr. Gracey and others, by means of dredges, since the region affords ideal conditions for this industry if the average gold contents of the placer prove sufficient, several of the lakes having banks of gravel just adapted for the work of a dredge, with plenty of room to dump tailings in comparatively deep water. If dredges can work at a profit gravel containing 10 or 15 cents per cubic yard, as is claimed, there should be opportunity in several parts of the region for successful mining, though in some localities the size of the boulders occurring in the gravel may prove a difficulty.

Before leaving this subject it must be stated that bedrock has practically never been reached, and there is a possibility that much richer stuff than any found near the surface may be awaiting the miner at suitable points for its concentration at bed rock. If the deposits were formed by a great post-glacial river this must almost certainly be the case. However, from the geologist's point of view the evidence is strongly in support of the action of great lakes as the cause of the gravels, and if this is correct it is doubtful if the gravel at bedrock will prove richer than elsewhere, though concentration about boulders by wave action, as at Meteor lake, may provide beds much richer than the average.

The source of the gold has not yet been determined, though we may suppose that quartz veins or stringers in Huronian rocks which have been removed by weathering, etc., have supplied it, especially since a rare quartz pebble shows free gold, and assays of washed pebbles, as proved by Mr. Wells, usually yield some gold. The rock immediatedly surrounding the richest gravel deposits are, however, usually either volcanic breccia, probably of Cambrian age as on the lower Vermilion, or Laurentian granite and gneiss as at Meteor lake, and rarely Huronian. It is likely that the auriferous gravel has really been brought for a considerable distance by glacial action, and then re-arranged by the work of lakes and rivers. Small quantities of gold have been found in vein quartz in the Huronian rocks of the region to the northeast and north as proved by Mr. Burwash[3] and Dr. Parks[4] ; and since the glacial striations run in the same direction this source of the gold is rendered probable.

3 Bur. Mines, 1896, p. 174. 4 Ibid., 1900, p. 141.

IRON ORES OF NIPISSING DISTRICT.

BY WILLET G. MILLER.

Introduction.

The discovery of iron ore in the vicinity of Lake Temagami was reported to the Director of the Bureau of Mines late in the autumn of 1899. As the ore was found to be associated with jasper and hence appeared to occur under conditions similar to those of the great deposit of the States of Michigan and Minnesota it appeared probable that the discovery might be of considerable economic importance. Jasper was known to occur in several parts of the field, and it seemed likely that a belt or range of iron ore associated with this variety of rock was present in the district. The writer was accordingly instructed to endeavour to determine whether such was the case and if so to locate the range as closely as time would permit during the past summer. He was also asked to make notes on any other mineral deposits of economic interest which might be met with in the progress of the field work.

The part of the district examined during the past season lies between Lake Temiscaming, which here forms the boundary between the Provinces of Ontario and Quebec on the east, and the Algoma boundary, in the neighborhood of the town of Sudbury, on the west. The most prominent natural feature in the strip of country examined between these two boundaries is Lake Temagami which lies about 25 miles west of Lake Temiscaming and 45 miles east of the Nipissing-Algoma boundary. The work of the season centred around this lake although trips were made from it both east and west.

As the section of country examined had a length of about 80 miles and a breadth in places of several miles it will be understood that little detailed work could be done in the time at our disposal. The present report therefore on this iron-bearing series of rocks must be considered as general or preliminary in character. The point of chief interest at present is the exact locations of the various known outcrops of ore, and all these will be found referred to in the report. They were found at intervals across nearly the whole length of the area examined.

As the Director of the Bureau of Mines was anxious to have the report published as early as possible time has not permitted, through pressure of other duties during the winter, of the making of a careful examination of all the specimens collected while in the field. It was thought moreover that a description of this material would find a more fitting place in a future and more detailed report.

Mr. I. L. Benn acted as field assistant during the season and the writer is much indebted to him for the interest he took in the work.

Special thanks are also due a number of gentlemen who rendered us every assistance in their power during the progress of the work. The writer is under obligation to Mr. D. O'Connor, who from his knowledge of the Temagami country was able to give us much information which saved both time and labor.

Former Reports on the District.

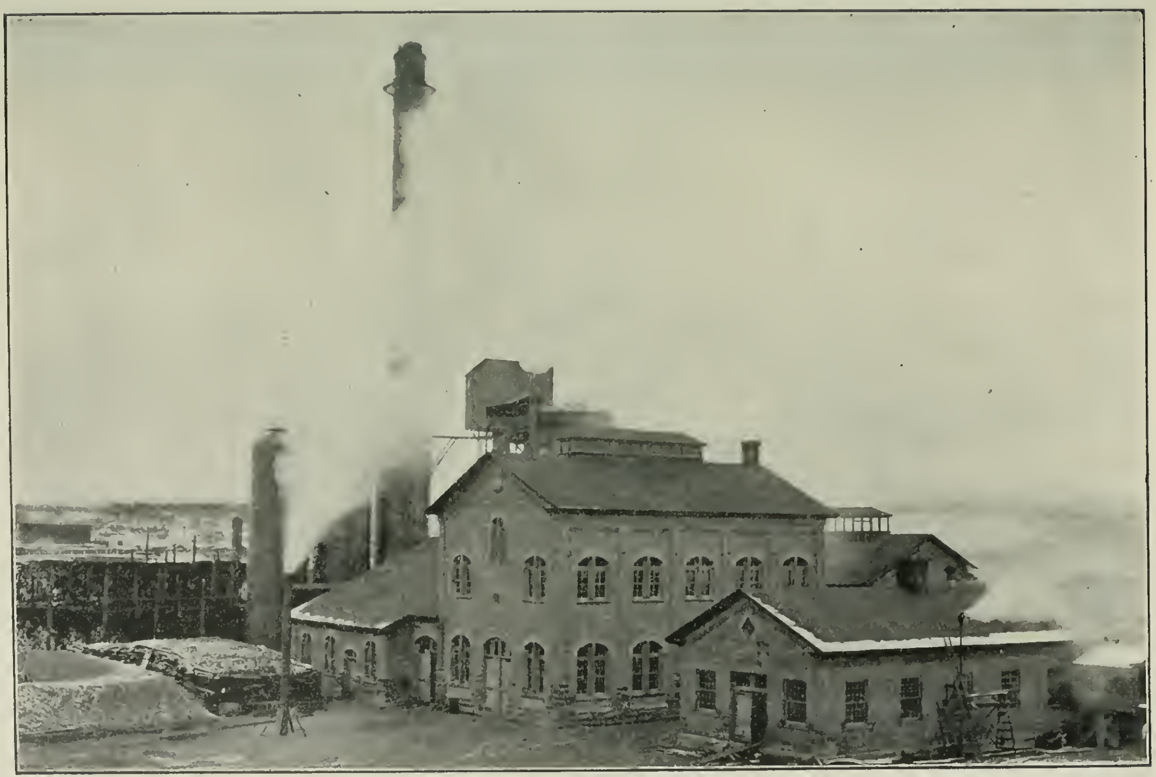
A part of the area in which these iron ores occur has been examined by the officers of the Geological Survey. The map which accompanies the report of Dr. Robert Bell, F.R.S., on the Sudbury district covers a portion of the more westerly end of the iron-bearing tract.[1] The more eastern and central parts of the area examined by the writer are embraced in the region covered by the geological map prepared by Dr. A. E. Barlow, M.A., in connection with his report on the Lake Temiscaming map-sheet.[2] This map and report of Dr. Barlow will be

[1] Report on the Sudbury Mining District with map, Ottawa, 1891.

[2] Report on the Geol. and Nat. Res. Nip. and Tem. map-sheets, Ottawa, 1899.

Onaping Gold Mining Company. Sluice Box and Pumps.

 Onaping Gold Mining Company. Sluicing Gravel.



[22] Smelting Works, Canada Iron Furnace Company, Midland.

frequently referred to in the following notes on the iron-bearing areas. Wherever in his description of the district the writer makes use of the terms "geological map" and "geological report" it is to be understood that the map and report intended, unless it is stated otherwise, are those of Dr. Barlow. Most of the writer's time in the field was spent on an area which is embraced in Dr. Barlow's map sheets.

The report of Dr. Barlow, which consists of some 300 pages, contains in addition to a geological description of the region some interesting notes on the early explorations and surveys, general physical features, climate, timber and fauna.

The report dealing with the areas covered by both the Nipissing and Temiscaming map-sheets describes a region of 6,912 square miles, the northeast corner of which lies in the Province of Quebec.

The strip of country examined by the present writer runs in an east and west direction near the centre of the region reported on by Dr. Barlow, and lies chiefly in the southern part of his Temiscaming map sheet, although it also covers a small area near the northwest corner of his Nipissing sheet. It also extends west into a part of the district which has not yet been geologically mapped, while the more southwesterly part of it falls within the Sudbury sheet of Dr. Bell.

Topography of the Region.

The most direct access to the eastern and central part of the area examined is via a branch of the Canadian Pacific Railway which runs from the town of Mattawa to Temiscaming station at the foot of the lake of the same name. From this station a steamboat can be taken up the lake to the mouth of Montreal river. Thence travel is by canoe up the Matabitchouan river to Lake Temagami and the surrounding district, which is well supplied with canoe routes.

At White Bear lake, 25 miles up the Matabitchouan from the mouth of this river which enters lake Temiscaming close to the outlet of the Montreal river, there is an Indian settlement. From White Bear lake to the Hudson Bay post on Bear island in lake Temagami the distance by canoe route is about 20 miles. From the southwestern end of lake Temagami, a canoe route leads to lake Wahnapitae which is connected by a good wagon road with the town of Sudbury.

There are other routes to the district surrounding lake Temagami, but that via the Matabitchouan offers the least difficulty to the traveller, and most of the outcrops of the iron-bearing formation to which reference will be made in this report are accessible from this route. Some of the outcrops in the western part of the area, however, are much more easily reached via lake Wahnapitae or by wagon roads and trails from Sudbury.

The surface of the country throughout most of the area examined is similar to that in many other parts of the Archæan regions of Ontario. Soil is scanty in most places, the surface presenting a succession of rocky ridges and knolls with intervening swamps. The larger hills rise to no great height above the surrounding country.

In the extreme eastern and western portions soil is more abundant than in the central parts. There are some very good areas of farming land in the vicinity of Sudbury, and there are also some small tracts of good soil near the mouth of the Montreal river. On the shores of White Bear and Temagami lakes small tracts of land have been cleared, but they are scarcely larger than garden patches.

The timber over some parts of the area has been burned, as it is in most places penetrated by explorers and lumbermen, but the district immediately surrounding lake Temagami is occupied by a green forest. This adds much to the appearance of this and adjacent sheets of water and no doubt contributes materially to the popularity of the district with tourists who are coming into the country in increasing numbers each year.

The numerous sheets of clear water tributary to lake Temagami are well stocked with the varieties of fish usually found in northern lakes, and game of different kinds is fairly abundant.

As a moose country, like that of the part of the Province of Quebec immediately to the east of lake Temiscaming, it is somewhat noted.

Details on the points just referred to will be found in Dr. Barlow's report, a copy of which should be in the hands of every one, whether tourist or mining man, who visits the district.

Geological Outline of the District.

Reference has already been made to the geological reports dealing with the greater part of the district examined. As the writer spent most of his time in the territory surrounding lake Temagami, which is embraced in the field reported on by Dr. Barlow, this gentleman's description of the geology will be made use of for the most part in the account of the rocks which follows.

The geological map shows that the part of the district with which we have to deal is occupied by rocks which, following the classification that has been in use for many years by the Canadian Geological Survey, can be divided roughly into two great groups named respectively Laurentian and Huronian. Each of these groups embraces rocks of different kinds, those of the Laurentian being largely of igneous origin, while among those of the Huronian are embraced numerous rocks, some of which were originally fragmental in character and others massive or igneous.

It may be said that in a general way both these great groups are similar in character to crystalline series which occupy the districts in which most of the great iron ore bodies of the States of Michigan, Wisconsin and Minnesota occur. In these States, however, the rocks which are known as Huronian in Canada are called, in general, Algonkian by most writers. As some of these iron ore-bearing districts of the United States have been studied in detail we in Ontario can obtain much useful information from the reports which embody the results of these investigations, and since the geological conditions in the iron ore fields on both sides of the border are so much alike we can apply the information which has been gained from the study of these great iron mining centres, in many respects the greatest known, to our own fields. It has taken many years to unravel the complicated structure of the ore belts of these States, and it is a fortunate circumstance to those interested in the development of an iron industry in the similar geological areas of Ontario that such valuable reports have been published.

In both the Ontario and United States regions rocks occur of later age than Huronian or Algonkian. The areas of these in Ontario are shown on the maps of Bell and Barlow. With the exception of glacial and recent deposits such formations were absent in the vicinity of the iron-bearing belt of the District of Nipissing, so far as ascertained by the writer.

The writer will concern himself only with the geology of the belt which embraces the ore-bearing formation and the immediately surrounding rocks.

Barlow's geological map of the district is as detailed as could be expected, considering the time and facilities he had of mapping so large and, so far as the geology is concerned, previously unexplored a region.

The iron-bearing formation lies in what the geological map shows to be Huronian rocks, with the exception of one or two small areas which are not readily accessible and were mapped Laurentian by Barlow. As the writer's work was restricted to the ore-bearing rocks, and as in order to follow them up it was necessary to do rather detailed work in places, he has necessarily examined some parts of the field, particularly those areas distant from water courses, more in detail than did the officers of the Survey. In the following description reference will be made to some corrections, chiefly of a minor character, which it was found neccessary to make in the geological map.

It is of considerable importance to the prospector or mining man in search of iron ore deposits in the district under review that he should be able to distinguish the rocks to which are

given the name Laurentian from those which are classified as Huronian, since it is only in the latter group that the iron-bearing formation is found. Moreover, it is important that he have some familiarity with the different members of the Huronian, as the ore formation is confined to a certain horizon of the latter.

A brief account will now be given of the characteristics and relations of the different rocks which make up the Laurentian and Huronian series. This description follows that of Barlow pretty closely. In the future it may be found necessary to reconstruct some of the theories concerning the relations of some of the members of the series, particularly of some of those more closely connected with the iron-bearing formation. As the present report deals with what can be called nothing more than a preliminary examination of the iron-bearing areas the relations of the rocks as given in the Geological Survey report will, for the most part, be accepted. In the description of special areas reference will be made to any corrections which appear to be necessary in the geological map or in the theories concerning the relations of the rocks given inthe geological report.

THE LAURENTIAN SERIES.

The series of rocks known as Laurentian covers the greater part of this portion of the Province. Dr. Barlow found in his examination of a large district that the rocks of this series here belong, for the greater part, to what has been called the Lower Laurentian or Fundamental gneiss. The rocks consist of a group possessing generally a foliated texture, and include a great number of varietal forms of granite, diorite and other related igneous masses. Being foliated in structure, these rocks are known as granite gneiss, diorite gneiss or by other names depending on their mineralogical composition. Some of these rock types, however, are without this foliated character and then are classified simply as granites, etc. The series may be said to represent "a complex of irruptive plutonic rocks of repeated intricate intrusion of acidic and basic materials."

A few very small areas in the region covered by the lake Nipissing map-sheet are occupied by crystalline limestones which belong to what has been called the Grenville series of the Laurentian. On the Keepawa river, which enters lake Keepawa just east of the boundary of Dr. Barlow's map-sheet in Quebec the present writer has discovered an area of crystalline limestone and nepheline-bearing rocks which seems to show that the Grenville series is in evidence in the territory just outside of the boundaries of the lake Temiscaming map-sheet.[3]

THE HURONIAN ROCKS.

The rocks of the Huronian series occupy for the most part depressions in the Laurentian which they overlie. In some cases these depressions are long and trough-like. In others they are quite irregular in form. Many of the deeper depressions over the surface of the district are now occupied by lakes. In a number of instances the writer found that the rocks immediately surrounding the shores of these lakes belong to the Huronian series which forms a narrower fringe around the lakes than is shown on the geological map. The shores of many lakes are more completely surrounded by Huronian rocks than is possible to show on the scale of 4 miles to 1 inch adopted in the construction of the geological map.

The contact between the Huronian and Laurentian series is an igneous one, the rocks of the latter series fusing into or cutting through those of the former. It is believed that the material of which the Laurentian is now composed represented the floor on which the Huronian fragmental rocks were deposited, and that subsequent to such deposition the material to which we now give the name Laurentian became molten or semi-molten and forced its way. to some extent,

[3] Am. Geologist, Jan. 1901.

up through the Huronian. The latter on the other hand sagged down more or less into the former. This theory accounts for the relations which we now find existing between the two formations.

The series classed as Huronian in this field consists for the most part of rocks which have an unmistakable appearance of being clastic or fragmental in origin. In the field some of them are seen to contain coarse fragments of different kinds, while others again have the appearance of ordinary slate and related rocks such as quartzite.

Dr. Barlow states that these Huronian rocks throughout the area wherever the series is fully represented are divisible into three distinct groups which in ascending order are as follows: (1) Breccia or breccia-conglomerate ; (2) Greywacké shale or slate ; (3) Felspathic sandstone or quartzite.

As the present writer's work during the past summer, though necessarily not very detailed, did not lead him to observe any defects in this classification of the Huronian series, it will be made use of in this report.

According to Dr. Barlow there is a gradual and perfect transition upward from one member to the other. He also contends that the breccia-conglomerate, greywacké and slates evidently represent volcanic ejectamenta which were showered out and spread over the bottom of a shallow ocean. This material is supposed to have been subsequently rounded and otherwise modified as the result of aqueous action. The quartzites at the top of the series are believed to represent the beginning of true sedimentation on a large scale.

In the districts south of Lake Superior which have received a great deal of attention from the geologists of the United States a somewhat similar but more varied assemblage of rocks is found in the iron ore fields, but it is claimed that the fragmental series which we here call Huronian there rests on the eroded surface of the Laurentian or, in other words, that the contact between these two series is not of an igneous nature.

The relations found to exist between an arkose and an underlying fundamental granite by Dr Barlow in one part of the field show however that in some parts of the district the relations between the overlying fragmental material and the fundamental gneiss are similar to those of Michigan and elsewhere between corresponding series.

DIABASE AND GABBRO.

Rocks of the character of diabase and gabbro are considered by Barlow to be contemporaneous in age with some of the fragmental rocks. [4] He believes them to represent the more deeply seated parts of masses which were connected with volcanic outbursts at the surface. In many cases some members of this basic igneous series are of considerably later age than the fragmental rocks which contain the ore horizon, as the latter series appears to be often much disturbed by the former.

This series of basic rocks, especially when in the form of dikes, cutting the ore-bearing formation has proved to be of great economic importance in some of the iron ore districts of the United States already referred to, as it is in association with the dikes that large bodies of "soft" iron ore or hematite are frequently found. In these cases the basic dike material is generally found more or less altered into a soft soapstone-like rock. The occurrence of these dikes through the ore-bearing horizon is a feature worthy the attention of the prospector.

GRANITE.

The view taken of most of the masses of this rock by Barlow is that they and those of diabase and gabbro represent differentiations of one magma, although their periods of eruption in

4 Report, page 104.

certain cases have been somewhat separated. The granite dikes and masses hold the same relations to the iron-bearing series as do those of the more basic igneous types already described.

PLEISTOCENE.

While in some parts of the area embraced in the lake Temiscaming map-sheet there are rocks of Palæozoic age, in the section of country examined by the writer during the past summer there are no intervening formations between the Archæan and deposits of glacial origin. The Pleistocene geology of the area with which we are more particularly concerned shows no phenomena of exceptional character, and differs little from that of most other parts of northern Ontario.

In the neighborhood of the town of Mattawa, however, the Pleistocene phenomena are of considerable interest and have been studied somewhat in detail by different writers, whose work is referred to in the Geological Survey report in which will be found numerous details of interest to students of Pleistocene geology.

As has been shown by the writer in other reports of the Bureau of Mines, glacial boulders can often be made much use of in locating mineral deposits. The majority of boulders in these northern districts are not far removed from their parent masses, and if we know the direction from which the glaciers have moved we can in many cases by following up the train of boulders find the material of which they are composed in place. That part of the field in which most of our work was done during the past summer, however, did not offer good facilities for this kind of work, as in many cases the surface is covered by a green forest which is often dense and difficult to travel through. In burned areas boulders are naturally much better exposed to view. In a few cases however we were aided in locating outcrops of jasper-bearing iron ore by finding boulders of the material.

In the search for these deposits we had other means of detecting them when in their vicinity. All the iron ore-bearing deposits examined contained magnetic oxide of iron. The presence of this mineral, as is well known, is readily detected by the dip needle. Hence the use made of boulders in prospecting was of less importance than in our work of other years. Moreover, having once discovered an area of Huronian rocks it was only a matter of ascertaining what members of the series were present in order to determine whether iron ores occurred in the area or not.

Included in the drift material derived from the erosion of Archæan rocks we observed a number of boulders of Silurian limestone which have been transported from the outlier of these rocks at the head of lake Temiscaming.

The Iron-Bearing Series.

The iron ore so far found in the district is what is known as magnetite or magnetic ore. In nearly every deposit so far discovered the magnetite occurs associated with jasper or closely related silicious material. In many cases the jasper and magnetite occur intimately interbanded. (Fig. 1). Sometimes as many as twenty-five or more bands can be seen by the naked eye in a width across the strike of one foot. Examined under the microscope parts of the bands are found to be made up of innumerable minute bands more or less parallel to one another.

When the jasper is of a bright red color, which it frequently is, the interbanded material has a striking and beautiful appearance, the black color of the magnetite contrasting well with the red of the jasper. At times bands or masses of magnetite are found of considerable width free from intermixed jasper.

This interbanding of iron ore and jasper is not unique as it is characteristic of some of the great iron mining regions of Michigan and Minnesota. In some cases in these States the interbanded ore is magnetite. In many others it is hematite.

As the term jasper will be frequently used in this report it will be well to define it here and explain its relations to other closely connected substances.

Jasper is opaque colored quartz. The color may be of various shades, including red—which we are accustomed to consider its normal color—brown, green, gray and black. Jasper is found associated with the magnetite of Nipissing in all these shades.

Flint, which is known to most prospectors, is similar in composition to jasper, but is less opaque and occurs in various shades of dull colors. It breaks with a deeply conchoidal fracture and a sharp cutting edge.

Hornstone resembles flint, but is more brittle and its fracture more splintery.

Chert is a term often used in the reports on the iron ores of Michigan and adjacent States. This name is frequently applied to hornstone, and to any impure flinty rock including the jaspers.

In the geological report on the Marquette iron-bearing district of Michigan by Van Hise, Bayley and Smyth, page 362, the term jaspilytes is thus defined "The jaspilytes are rocks consisting of alternate bands composed mainly of finely crystalline, iron-stained quartz and iron oxide. . . . . The iron oxide is mainly hematite, and includes both red and specular varieties, but magnetite is frequently present."[5] On page 363 of the same report the following statement is made, "The jaspilyte differs mainly from the ferruginous chert, with which it is closely associated, in that the silicious bands of the former are stained a bright red by hematite, and the bands of ore between them are mainly specular hematite, while in the cherts the iron oxide is earthy hematite."

In the present report jaspilyte will be used as a convenient term in referring to the outcrops of interbanded magnetite and silicious material, no matter what the color of the latter may be, it all being jasper or very closely related thereto.

Position of Ore Horizon in Huronian.

The magnetite bearing horizon in this part of Nipissing lies in or associated with what the Canadian Geological Survey maps as graywacké and slate. This it will be remembered from the description already given is the middle member of the Huronian series.

This iron-bearing horizon attracted little attention till recently. Outcrops of the jasper and iron ore had been observed in several parts of the district, but as the ore was rather intimately mixed with the jasper no importance was attached to them by the discoverers. The ore was thought to be of too low a grade to be of economic value, and the significance of this association of ore and jasper was not understood. The fact that large bodies of marketable ore occur at certain points along similar belts in other countries was not known to the prospectors in the district.

The circumstance that there was considerable disturbance of the compass in some parts of the district was observed by officers of the Geological Survey when they were making their examination of the district. They also noticed some outcrops of interlaminated bands of magnetite and silicious material, but did not happen on outcrops of the more striking bands of highly colored jasper. Hence it was but natural that they were not struck with the resemblance of the field to the iron-producing districts to the south and west of lake Superior.

Some of the prospectors a few years ago, when the district first attracted attention as a mineral region, were struck with the peculiar arrangement of the ore and enclosing rock, and as it was rich in silica they naturally thought it might be an auriferous formation. After having had samples assayed for gold however, they came to the conclusion that it was of no economic importance and paid no further attention to it. The writer found, however, on describing the structure to them, that many prospectors remembered having seen outcrops in various parts of

[5] U.S. Geol. Survey, Monograph No. XXVIII.

the field, and the information with which they furnished us was of much assistance in our work of locating the ore-bearing belt.

Location of Jaspilyte Outcrops.

At the time we began work in the fiel l last July jasper had been reported to the Director of the Bureau of Mines as occurring at two or three places in the district. Mr. E. M. Burwash had found outcrops of it in 1896 near the 61st mile post on the boundary between the districts of Nipissing and Algoma, and described the occurrence in his report to the Bureau for that year. Mr. D. O'Connor had likewise found magnetite interbanded with jasper near the end of the northeast arm of lake Temagami and also in the vicinity of Kokoko lake, and had furnished the Bureau with samples from the latter locality.

When beginning the work we thought that these outcrops discovered by Mr. O'Connor probably lay in the same belt as those discovered by Mr. Burwash. As the field work progressed, however, we came to the conclusion that there are two or more somewhat parallel belts which have a roughly east and west course across the district.

Time did not permit of our visiting the outcrop discovered by Mr. Burwash. It was, however, examined by Dr. Coleman, who had charge of the work of locating the iron ore-bearing series to the west, in the district of Algoma.

Work in the Field.

On beginning work in the field the writer went first in company with Mr. D. O'Connor to visit outcrops containing jasper and magnetite, discovered by the latter in the vicinity of lake Temagami.

The first discovered outcrop of jasper encountered on the route in from lake Temiscaming to Temagami by way of White Bear lake is that which lies along the eastern extremity of the northeast area of lake Temagami between a small body of water known as Snake lake on the east, and Tetapaga lake on the west.[6]

SNAKE LAKE.

This belt of interbanded jasper and magnetite or, as we shall call it, jaspilyte, runs out on the east close to the northwest arm of Snake lake. From this point it has a westerly course to the south side of Turtle lake and on to the vicinity of Tetapaga lake.

The jasper interlaminated with the magnetite in the vicinity of Snake lake is of different colors, the red at times giving way to white and gray.

The rock most closely associated with the jasper here is a dark slate, which passes into a graywacké-like type. Between the bands of jasper at times there are also dike-like bands of a soft rock resembling soapstone which are conformable to the strike of the jasper and occasionally have a width of three feet or more, the thickness of the bands of jasper being measured by inches. Some of the bands of magnetite interlaminated with the jasper have a thickness of about one foot. Immediately to the south of the eastern end of the jaspilyte band is a swampy depression. Rising through this to the height of a few feet above its general level is a "hog's-back" of gabbro which follows the same general course for a short distance as the jaspilyte.

Up to a point about 200 yards west from the northwest arm of Snake lake the jaspilyte band stands up clear and distinct above the swampy ground. At this point, however, it ends somewhat abruptly, disappearing in the swamp, and we were not able to pick up a continuation of it further to the east.

6 A small outcrop of jaspilyte was discovered by Mr. O'Connor late last autumn, 1900, in the vicinity of McDonald Creek to the east of the east end of Rabbit lake. It is said to be similar in character to those in the vicinity of Snake lake.

Along the north of the band of jaspilyte for a distance of some hundred feet or more from its eastern end there is a band of carbonaceous or graphitic slate or schist. This graphitic material has been opened up at two places and the rock is seen to carry considerable carbonaceous material. The nearest of these openings is about 200 yards from the bay of Snake lake to which reference has already been made. A trail runs from the bay to these openings and continues along the jaspilyte band to the westward. The occurrence of this carbonaceous material so closely associated with the jaspilyte is of interest, as a similar association is found in some parts of the Michigan iron belts.

Snake lake is not named on the geological map. It lies between the most western part of White Bear lake and the eastern extremity of the northeast arm of lake Temagami, being connected by one portage with the former and by two with the latter.

From the point where the trail, to which reference has been made, strikes Snake lake to the first opening in the carbonaceous material is a distance north of about one quarter mile. There is considerable pyrite, more or less decomposed, associated with the graphite.

The greywacké or slate seems to have been saturated originally with a carbonaceous liquid which, having been subjected to heat and pressure during the progress of metamorphism of the rocks, has given rise to the graphite.

The magnetite and jasper at the eastern end of the band is mixed considerably with rock, (graywacké), and seems to die out gradually. Across the depression east of the end of the belt the dip needle gives no indication of the presence of magnetite. The cause of the concentration of the carbonaceous material near the end of the belt is not easily explained.

It would appear as if this graphite and the coal-like substance occurring in the vicinity of Sudbury, in the township of Balfour and elsewhere, had a similar origin. The material in the vicinity of the end of the northeast arm of lake Temagami, however, has been subjected to more profound metamorphic action, with the result that graphite has been formed, while the Balfour material has been less highly metamorphosed and a substance practically identical in composition with anthracite has been produced. The Balfour mineral contains, however, considerable intermixed quartz and other materials. [7]

Fig. 1 shows the interlamination of magnetite and jasper at a point about one-half mile west of Snake lake. The bands are somewhat contorted here and are often broken across, the cracks being filled up with white quartz.

Proceeding westward from these outcrops of jaspilyte, near the northwest bay of Snake lake, the band can be traced to the western end of Turtle lake, a distance of about four miles. In some parts of its course the band has a width of 500 feet or more. It enters the east end of Turtle lake, follows along its southern shore and is exposed south of the lake. The northern edge runs through about the centre of the lake, exposures of the jaspilyte showing at either end of the lake. A short distance to the east of the lake the jaspilyte outcrops on the hills.

No outcroppings of iron ore were seen immediately to the west of Turtle lake in the vicinity of Tetapaga, nor were any indications of the presence of magnetite obtained by the use of the dip needle.

A short portage leads from Turtle lake to Temagami. At the point where it leaves the former lake there are some large angular blocks of jaspilyte. Another portage leads from Turtle to Tetapaga lake. On the west end of the former lake a point on which jaspilyte outcrops is passed in going by canoe towards the portage leading to Tetapaga.

MATAGAMA POINT.

From this portage no iron ore was seen along the northwest shore of the northeast arm of Temagami till the vicinity of Matagama point is reached. Near the shore about one mile northeast of this point there are some large angular blocks of a dark, chloritic rock with magnetite

[7] Bur. Mines 1896, pp. 159 to 166 and Trans Can. Inst. April 27th, 1897.

mixed through the mass in considerable proportion. Inland west of this some distance are some openings which were made about two years ago in a deposit consisting of magnetite and pyrite in a chloritic ground mass. The needle dips for some distance across the strike here. From the openings the band was traced westward to a little bay which lies a short distance north of the house at the outermost part of Matagama point.

About one mile south of this house there is an outcrop of magnetite on the east side of Temagami island on which a little stripping has been done. The rock in which the mineral occurs is dark and chloritic in appearance and is much rusted. Some large pieces of pretty pure magnetite were obtained here. Dolomite is associated with the ore, which is coarse in grain and more like some of that found in some parts of eastern Ontario than the magnetite associated with jasper in the district. The needle dips strongly in the vicinity of the exposure, but a short distance in from the shore no dip is observable. This outcrop of magnetite on the island seems to be a continuation of the band which runs out on Matagama point.

On the shore of the mainland immediately east of the outcrop on the island the rock is much rusted. The needle shows only a slight dip here. The strike of the rock is about parallel with the shore line.

An analysis of a sample of the magnetite from the island made by Mr. J. Walter Wells showed the following composition : Metallic iron 65.82 per cent., silica 3.60 per cent., sulphur .096 per cent., phosphorus .04 per cent., manganese trace. There was no titanium present.

Bands of rusty rock in which at times occur comparatively large deposits of pyrite and pyrrhotite are found running parallel to most of the jaspilyte bands in the district. Sometimes the two bands lie quite close together but they are often separated by a distance of several hundred feet.

The rusty band of rock paralleling the magnetite deposit on Temagami island has its counterpart along the southeast shore of the northeast arm of lake Temagami. A short distance inland from that part of the shore opposite Ferguson's point and the portage to Turtle lake there is a band of rock highly impregnated with iron pyrites. This band runs about parallel with the jaspilyte band in the vicinity of Turtle lake, and has been opened up at two or three points. Samples taken from these openings, which were selected more with the object of determining their gold contents than the percentage of sulphur in them gave the following results on analysis : gold $1.40, copper .48 per cent., nickel .27 per cent., sulphur 26 20 per cent.

At Ferguson's point a pit has been sunk in quartz and dolomite. The appearance of these two minerals in association here is interesting, as the mixture of the two resembles closely the gangue of some of the auriferous mispickel ore bodies in Hastings county. There are other masses of more or less silicious dolomite along this arm of Temagami, in Emerald lake and elsewhere. These will be referred to again. Occurring as they do in proximity to the bands of magnetite, it would seem that the theory held by some to the effect that the iron ores of Michigan and Minnesota were originally in the form of carbonates may be applied to this district.

VERMILION LAKE

A band of jaspilyte runs a short distance to the south of Vermilion lake. It extends in a westerly direction with interruptions to Kokoko lake and eastward.

The southern shore of Vermilion lake is occupied by a band of rock which is highly impregnated with iron pyrites, and pits have been sunk in this band at two or three points exposing massive deposits of this mineral.

This pyrite band extends westward into O'Connor lake, which lies a short distance from Vermilion lake but is not shown on the geological map. The rock carrying the pyrite is exposed on an island in O'Connor lake opposite the end of the portage leading from Vermilion, and rusty rock is also visible along the southern shore of the former lake. The band of rock

carrying the pyrites continues eastward from Vermilion lake some distance, and a number of locations have been surveyed on it in the area lying between Vermilion and Net lakes. Outcrops on some of the points and islands of Net lake also belong to the same band.

Not far from the eastern end of Vermilion lake and close to its southern shore there is an islet which is composed of a variety of breccia-conglomerate which is somewhat rare in the district. The base of the breccia is a chloritic material which cements together numerous angular fragments of jasper and magnetite. Some of these fragments are small grains, while others have a diameter of 8 inches. The islet itself is only a few feet across (*Fig. 2*).

A careful study of the relations of this breccia to the pyrite band and the unfractured jasper and magnetite might throw considerable light on the origin and relative ages of these members of the Huronian series. It will be seen from what has already been said that the pyrite band lies between the breccia islet and the belt of interbanded jasper and magnetite. It would appear as if the pyrite had been introduced after the jasper-magnetite had been disturbed, giving rise to the brecciated material.

Vermilion lake lies in a narrow depression which continues northeastward to Net lake. Two or three small marshy lakes or ponds lie in the depression between these lakes.

The first of these ponds to the northeastward whose outline is shown on the geological map is known as Duck lake. The jaspilyte band lies a short distance south of this lake and is situated in rather high ground.

About a quarter of a mile northeast of Duck lake is another small heart-shaped pond a few acres in extent which is not shown on the map. A good deal of magnetite is exposed in outcrops on the bluffs on the north side of this pond, and represents a continuation of the Vermilion and Duck lakes band. For convenience in description we have called the heart-shaped pond Heart lake.

The band was traced a half mile or so, by dip needle and rock exposures, northeast of Heart lake, but dies out before it reaches Net lake.

Some stripping has been done on the band towards its northeastern extremity and the brushwood has been cut off the outcrops on the banks of Heart lake. The magnetite lies along the northern and eastern shores of the lake which, as already stated, occupies a part of the valley extending from Vermilion to Net lake. On the opposite side of Heart lake there are outcrops of rock which contain a considerable percentage of pyrite. This rock has been stripped and shallow pits have been sunk in it. Other outcrops of similar rock occur on the western side of the valley between this point and Vermilion lake.

At the western end of Vermilion lake, nearly opposite the portage to O'Connor lake, a large mass of angular blocks of magnetite and jasper form a talus along the base of a cliff, the end of the lake here having broken across the strike of the rocks.

O'CONNOR AND IRON LAKES.

The iron band can be traced almost continuously for some distance west of this point and runs a couple of hundred yards to the south of O'Connor lake. Followed westward it expands and has a breadth of about 600 feet in the vicinity of Iron lake, forming part of the southern shore of this small body of water.

South of Iron lake the jasper has the normal red color for the most part and forms a striking interlamination with magnetite. At one point where the covering of moss had been removed from the rock about 300 layers, jasper and magnetite alternating, were observed over a width of 4 yards in a direction perpendicular to the strike. The jaspilyte has a nearly vertical dip.

In the vicinity of Vermilion lake the silica interbanded with the magnetite is not of a red color, but varies from almost black to light grey or white.

Iron lake, which lies about one-half mile west of O'Connor lake, is not shown on the geologi-

cal map. A trail runs from the southwest corner of the latter lake to near the south shore of the former where some stripping has been done.

A location has been surveyed to the south of O'Connor lake, one of the east and west lines of which strikes the shore of Vermilion lake not far from its southwest end.

The jasper-iron band is strongly developed immediately south of Iron lake. The surface of the band runs down to near the edge of the lake. Back from the lake it rises into a ridge which has a hummocky surface. The jaspilyte is for the most part covered by a layer of moss which however is not firmly attached to the rock surface and can be readily pulled off. When the surface is freshly uncovered the interbanded red jasper and magnetite, being moist, have a very striking and beautiful appearance. As the surface dries the colors become duller.

Some of the layers of magnetite are here interbanded with a softer material which weathers away, leaving the former standing up and producing a rough surface (*Fig. 3*). Where the iron oxide is associated with the jasper, as most of it is here, the two materials show little trace of weathering and the surface of the rock where it has been glaciated is quite smooth and well polished.

In part of the section of the jaspilyte which was photographed (*Fig. 4*) there is a layer of soft, grey-weathering rock interlaminated with the magnetite and jasper. This layer has a width of 16 inches. The bands of silica on each side of this layer are colorless for a foot or two from it. Along one side of the gray rock mass there is a band of quartz about 3 inches wide which however is only 3 or 4 feet in length. It is difficult to say what this layer of rock has been originally as it is much weathered but it appears to belong to the slate or graywacké series and contains some decomposed pyrite.

The bands of magnetite and jasper have been fractured and little stringers of quartz run across them in different directions.

Iron lake is reached by way of Tetapaga lake. The Indians portage across through the bush between the two lakes, there being no trail.

KOKOKO AND FERRUM LAKES.

The area between Vermilion and Kokoko lakes, which has a diameter of about six miles, lying away from main water routes, has not been surveyed. The geological map being the first one made of the district naturally does not give details of such inaccessible areas. A width of four miles across this area is shown as being occupied by granite. From our work we learned that this is incorrect as the jaspilyte band stretches, from Vermilion lake past the south of O'Connor and Iron lakes. Immediately west of the latter lake there is an extensive outcrop of greenstone, west of which granite is again exposed. On the eastern side of the small lake known as Business lake the jaspilyte outcrops. A line running west from here marks approximately the boundary between the greenstone area to the north and the granite to the south. Some distance east of Kokoko lake jaspilyte outcrops occur and form a continuous band to the shore of the lake.

This belt from its breadth, the appearance of the jasper and the association of basic igneous rocks with it has the appearance of being well worthy of careful investigation by those desirous of locating large bodies of iron ore.

The band enters Kokoko lake a little north of the west end of a small lake or bay which is shown on the geological map lying close to the middle of the eastern shore of Kokoko. This small lake, which can be entered from the larger one by canoe, will for convenience in description be called Ferrum lake.

About one quarter mile south of this small body of water a trail runs in from the shore of Kokoko lake a short distance to some openings which have been made in a pyrite deposit. This mineral occurs in considerable amount here and through its decomposition the rocks are much stained.

Immediately north of the stripping on the pyrite deposit there is a well defined valley, along the southern face of which are la ge angular blocks of interbanded jasper and magnetite. Not far from the shore of Kokoko lake this valley or ravine expands into a small beaver meadow which has a creek running through the centre of it. Outcrops of jaspilyte are exposed as the ground begins to rise on the north side of the valley, and the band of this material has a width of some hundreds of feet.

The direction followed by the band from here is northwest. It crosses near the western end of Ferrum lake and runs into Kokoko lake between the outlet of the lake just mentioned and a point of land which projects into Kokcko lake a few hundred yards north.

Boulders composed of interlaminated jasper and magnetite lie along the shore, and the band is represented by a shoal, the rock of which it is composed coming quite near the surface of the water. By means of the dip needle and canoe the band was traced out into the lake a couple of hundred feet, but was not found on the opposite shore.

The geological map represents the eastern shore of Kokoko lake as being bordered by a mass of breccia-conglomerate having a breadth of about one mile. Beyond this and extending for some distance the rock outcropping at the surface is indicated as granite. We found this to be incorrect. The conglomerate bordering the shore of the lake has a breadth in most places of only a few yards or feet, and is bounded on the east, north of Ferrum lake, by greenstone. From the shore of Kokoko lake a short distance north of the outlet of Ferrum lake we proceeded inland between two and three miles in a direction north of east and found that the area here is occupied almost entirely by greenstone, and not by granite as shown on the geological map. Granite, however, comes in near the northeast corner of Kokoko lake as shown on the map.

The separation between the breccia-conglomerate and graywacké and slate is not so sharp as the map shows it. The large island near the centre of the lake, for instance, is made up of rock in which are embedded numerous, fairly large-sized boulders. The smaller islands and points to the west are also composed of conglomerate. The islands to the south are of slate, as is the shore of the southern part of the lake. The conglomerate seems to form a point running out into the lake and embracing the islands to which reference has been made.

A portage leads from the northeast corner of Kokoko lake towards Squirrel lake. We followed this up some distance and examined the high hills which lie to the north of the north end of Kokoko lake. These hills appear very prominent from the lake and on the geological map are shown as being composed of greenstone. We found, however, no greenstone in their vicinity, the hills being slate with here and there coarse masses of conglomerate.

These prominent hills are of about the same height as the point of greenstone which runs out between Sandy inlet and Ferguson bay on lake Temagami. The point having been examined, and the hills having in all probability been seen only from a distance, it is quite natural that the latter shound have been put down on the geological map as being of the same composition as the point.

Kokoko lake is practically surrounded by what is in some places a narrow band of slate and conglomerate. The lake thus occupies an area of the fragmental rocks which fills in a depression among masses of igneous rocks.

There is some very highly fissile gray rock forming a narrow band in the valley of the stream which flows from the northeast into Ferrum lake. The well defined schistosity of the rock seems to be due to the pressure exerted on it by eruptions of igneous masses on either side. As already stated the rock north of this stream is greenstone for about three miles from the shore of Kokoko lake. A short distance south of the stream and about a mile and a half from the shore we climbed a prominent hill which is composed of what appears to be diabase.

These greenstones seem to have been intruded into the fragmental rocks and the latter appear to have been considerably disturbed.

PARALLEL BANDS OF JASPILYTE AND PYRITE

It will be remembered that we described the pyritous band of rock which runs parallel with the jaspilyte as lying to the north of the latter in the vicinity of Vermilion lake and eastward. The Snake lake and Turtle lake band lies parallel with the pyrite-bearing belt, which runs along the shore of the northeast arm of Temagami south of Ferguson's point.

It will thus be seen that the relative position of the two bands in the last mentioned locality are the same as in the vicinity of Kokoko lake, and that they differ from those in the vicinity of Vermilion lake, the pyrite band in the latter case lying to the north of the jaspilyte.

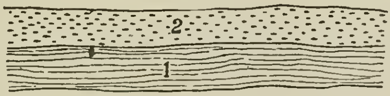
The occurrence of two bands of jaspilyte in a rudely parallel position, such as the Vermilion lake band and the Snake lake and Turtle lake band, within a few miles of each other is, we believe, rather uncommon in the districts so far examined, in which iron ores and jasper of similar character to these are associated. The occurrence of two such bands here together with the fact that in one case the accompanying pyrite band lies to the south of the jaspilyte, while in the other it lies to the north of it, can be explained by assuming that while the jaspilyte lay in the horizontal position in which it had originally been deposited the pyrite layer was formed above it. Afterwards, during the time of eruption of the greenstone masses, a period of great disturbance in the district, these two layers of rock were broken across or arched up in places. On one side of the arch of these layers of rocks, let us say, such as covered the greenstone mass which is shown on the geological map as occupying a considerable part of the area lying between Turtle and Vermilion lakes, the dip would be to the north, while on the other side it would be to the south. On the upper part of the arch or anticlinal fold being removed by denudation the resulting structure would consist of a band of jaspilyte on either side of the now exposed greenstone area. The one on the south would have its parallel pyrite band lying to the southward, while the jaspilyte to the north of the greenstone would have a parallel band of pyritous rock lying to the northward of it. Such is the arrangement of the rocks as we now find them in the area lying to the north of the end of the northeast arm of lake Temagami.

Or the pyrite might not have been in place at the time of the eruption of the greenstone. The rock in which the mineral now occurs probably overlay the jaspilyte, or what represented the jaspilyte, at this time, but the pyrite may have been subsequently introduced, the rock being of a porous character suitable for the deposition of such material.

No doubt the problem can be solved by more detailed work in the field than we were able to do.

There is every reason to believe that the jaspilyte at one time covered a much larger surface area than it does at present. The bands of these materials as we now find them represent the lower parts of an anticlinal fold.

A.



B.

Fig. A. and B.—Hypothetical vertical sections.

A.—Original horizontal arrangement of jaspilyte, graywacké and pyritous band.

B.—Structure produced by greenstone eruption. The greenstone area now has a band of jaspilyte on either side of it, these bands being rudely parallel to each other.

A portage leads from the western point of Kokoko lake to Temagami lake. The rock on this portage is marked greenstone on the geological map, but it has a slaty fracture and resembles quartzite. Greenstone comes in near the mouth of the inlet leading from the west end of the portage to Temagami and is not nearly so wide as the geological map shows it to be.

For some distance up the east shore of Temagami lake from this point the rock is slate, not conglomerate as shown on the map. On the east shore of Ferguson bay this slate dips at a low angle to the northwest, the original bedding and the cleavage of the slate being parallel. A little above Devil's hill, however, the slate stands on edge and shows an association of darker and lighter bands which are almost as striking in appearance as those of the jaspilyte.

AUSTIN BAY OF LAKE TEMAGAMI.

At the head of Austin bay which forms the southern extremity of the south arm of lake Temagami there is a band of rock composed of a mass of interbanded magnetite and what corresponds to the jasper of the bands which have already been described. The silica here interlaminated with the magnetite has not the red color of typical jasper, but since it is similar in origin and form to true jasper we shall use this term in speaking of it.

The most accessible outcrop on the band lies close to the water's edge somewhat east and south of the most western point of the bay. It shows on the northern face and on the top of a prominent hill which can be seen for some distance out in the lake.

Along the water's edge at the base of the hill there is a deposit of quartz containing some mispickel or arsenical pyrites. This deposit comes right up against the jaspilyte and, so far as the writer knows, is a unique occurrence, he having seen no reference to such a close association of mispickel and jaspilyte in the literature of other regions.

The quartz vein or deposit runs in a direction about perpendicular to the strike of the jaspilyte. This quartz is no doubt of similiar origin to numerous other veins and stringers of quartz which occur in association with the jaspilyte and which very frequently, especially the more minute ones, occupy cracks and fissures in it.

In later pages a mispickel deposit, which occurs a short distance south of Net lake, some 25 miles to the northeast, will be referred to, but this deposit is not associated with jaspilyte.

Some work has been done on the Austin bay deposit and fresh surfaces of quartz carrying mispickel are exposed. The jaspilyte band lying on the hill above this deposit is composed of thin bands of magnetite interlaminated with what we shall call white jasper. This latter material however at times takes on a darker color. The band has a width of about 375 feet and its strike is about west, or slightly north of west. The layers of magnetite and jasper dip northward at an angle of about 50 degrees. Going across the strike of the belt the needle dips strongly at three different points from 25 to 50 yards apart. Between these points the dip is slight, showing that certain parts of the belt are higher in magnetite than others.

A short distance to the westward the belt is broken across by the western extremity of the bay. West ot this the jaspilyte rises into hills of considerable height. In parts of the belt here the magnetite is not abundant and the dip of the needle is accordingly weak. About a mile west of the head of the bay the hills die down and beaver meadows and small lakes come in between them and the shore of the southwest arm of lake Temagami. In this low-lying area no outcrops of jaspilyte were observed and no indication of the presence of magnetite was obtained by the dip needle.

A chain of small lakes lies in here by way of which there is a canoe route, running in a northeasterly direction, connecting a small bay of the south arm with a bay on the southwest arm.

SOUTHWEST ARM OF TEMAGAMI.

A group of islands, close to the eastern shore of the southwest arm of lake Temagami, lies about two miles directly west of the jaspilyte outcrop on Austin bay, and a similar occurrence

of magnetite is found on the southern end of one of the larger of them. The rock has been stripped here and some of the material has been blasted out. This outcrop is thus described in the Geological Survey Report : "The exposure seen consisted of alternate bands of light-and dark-gray quartzite, the dark bands being composed almost wholly of grains of magnetite. It is curiously contorted but has in general a dip N. 7° E. 45°. In immediate contact with this to the south is a band of disintegrating greywacké and chlorite schist, dipping N. 9° E. 55°. This is filled with pyrite which has evidently been the chief cause of its decomposition. The local attraction of the magnetic needle was so great at this point as to render the compass practically useless." It will be noticed that the name quartzite is given to the bands of silica interlaminated with the magnetite. While similar in chemical composition to normal quartzite this material is believed by the present writer to be of different origin, one substance being a precipitate from solution while the other is a mechanical deposit.

By means of the dip needle we traced the band on which this outcrop occurs clear across this island and across the adjacent island to the west. On the latter very little rock is exposed along the band but the needle showed a strong dip. Beyond this point in the lake however we found no trace of the band. On the west shore of the southwest arm, opposite these outcrops on the islands and for some distance in a north and south direction, greenstone comes in close to the shore. Only a thin fringe of conglomerate, in place of the wider band shown on the map, lies along the shore here.

My assistant traced the jaspilyte band with breaks at various points in a southeastward direction from the head of Austin bay to near the southern end of Cross lake. The band was followed about one mile eastward from Austin bay, when gabbro came in across the strike. Farther on the band was picked up again and traced a distance of about two miles to near the vicinity of Cross lake. In this part of the field the pyrite zone with considerable associated quartz lies to the south of the jaspilyte belt.

EMERALD LAKE.

Emerald lake, which lies near the southwest corner of the Temiscaming map sheet, can be reached by way of a series of portages leading from lake Temagami into Gull and other lakes. It has not been surveyed and is shown by a sketch on the geological map.

Gull lake is almost completely surrounded by greenstone, but there are some exposures of conglomerate near the south end.

A few years ago Emerald lake attracted considerable attention from prospectors on account of the reported occurrence of gold on its shores. The gold was said to have been found in the loose state in grains of considerable size, mixed with sand, in a small cave, or so-called "vug," near the water's edge. Small openings of this character occur along the eastern shore about half way up the lake. Rock had been blasted out here at different points, but we saw no signs of the precious metal in the quartz in which the openings had been made. Considerable pyrite, some of which is in well defined cubes, occurs in these openings.

Jaspilyte is found in the cliff overhanging these quartz deposits. The band of this material here has a considerable width and was traced some distance back from the shore. The jaspilyte strikes the shore of the lake at a point along the south face of which there is a deep bay stretching to the east.

Not far south of this point is the largest island in the lake, which rises to a considerable height. Jaspilyte outcrops in the northwest corner and runs inland. The magnetite here forms a high percentage of the rock and is quite massive. A pyrite-holding band lies on both sides of the jaspilyte. This island has been surveyed, as have also other areas around the eastern shore of the lake.

No outcrops of jaspilyte were found on the western shore of the lake.

Greenstone bounds the west shore of Emerald lake with the exception of a point, opposite the large island, which is composed of slate. The outcrop of this rock, however, does not extend far inland.

On the north side of the bay, which forms the southeast corner of the lake, a small mass of conglomerate is exposed associated with dolomite, which has a rather striking appearance on weathered surfaces.

A trail runs from the shore of the lake westward from about opposite the point on which occurs the first outcrop of jaspilyte, to which reference was made, and leads to a small lake, which is surrounded by greenstone and lies about one half mile from the shore of the larger lake.

A small lake is shown on the geological map as lying west of the south end of Manitopeepagee lake. From the latter lake we portaged into the former and examined a quartz deposit situated on the top of a high greenstone hill, which rises from the east shore of the lake.

Considerable work has been done on this deposit, which is known in the district as the Turcott mine. The vein of quartz is about five feet wide and dips at an angle of about 35 degrees to the south.

LAKE OBABIKA.

In addition to the route leading from the southwest arm of Temagami to Emerald lake there is another route from Temagami by way of Obabika lake, which presents less difficulty than the former one. It passes from the western extremity of the northwest arm of Temagami, Obabika bay, through a small nameless lake, which is connected by a canoe channel with Temagami, into Obabika. The portage connecting the small lake with Obabika is not of great length and is well cut out.

The southern extremity of Obabika is connected with the northern end of Emerald lake by two portages and a small lake.

The crooked narrows in Obabika bay about one-half mile east of the small lake on the route into Obabika lake is shown on the geological map to be bounded by greenstone. The rock bordering the narrows here and outcropping in the centre of the channel is really granite.

Coming up the channel of Obabika bay from the east a light colored rock can be seen for distance of about half a mile. This is the outcrop of granite at the narrow bend in the channel, the bend being apparently caused by the granite cutting across it. The granite extends along the south shore of the bay, some little distance west of the narrows.

The outcrop of granite which has been referred to as occurring at the north-east corner of Kokoko lake is in line with the outcrop on Obabika bay. A glance at the map will show that the two outcrops are connected by what is apparently a line of weakness in the rocks.

The outcrops of rock on the shores of Obabika lake are shown on the geological map. Considerable sand is deposited along the west side of the narrows in the lake.

A rather striking example of the destructive effects produced by wind on timber is seen on both sides of the lake not far north of the narrows. On the east shore there is a hill of considerable height. Across this in an east and west direction a belt a hundred yards wide or so has been swept clean of standing timber On the opposite or western shore is the continuation of this belt. The elevation here is much less than on the eastern shore, but the effects of the wind have been the same. Just north of the outlet of the lake, Obabika river, the slate near the shore contains numerous quartz stringers on which some blasting has been done. The quartz is, however, quite barren.

A rough survey line has been run across the most prominent point on the western shore of the north half of the lake. A short distance in from the shore stringers of quartz occur in the slate. Some of the quartz is stained with malachite and iron pyrites is associated with it.

Interbanded Magnetite and Jasper west of Snake lake. *(Fig. 1)*.

 Breccia of Jasper and Magnetite in Chlorite Base: Vermilion lake. *(Fig. 2)*.

Magnetite interbanded with softer Layers of Rock : Iron lake. *(Fig. 3).*

 Exposure of Jaspilyte south of Iron lake. *(Fig. 4).*

ROUND LAKE.

Round lake lies on the western border of the Temiscaming map sheet. My assistant found the rock on the south, north and west shores of this lake to be breccia-conglomerate. The same rock also extends for a distance of about three miles south of the lake. An old shore line of the lake lies about three miles farther south than the present one.

There is a burned plain occupying 1500 or 2000 acres to the south of the lake.

LAKE WAHNAPITAE.

Between Emerald lake on the east and Wahnapitae lake on the west no outcrops of jaspilyte have been reported. A short distance to the north of the latter lake, however, the material was found in place some years ago by Mr. Henry Ranger of Sudbury, who showed us the outcrops. At the time when the material was found there was a gold excitement on in the district and as some of the layers in the jaspilyte are highly silicious and quartz-like in appearance, it was natural that they should have been taken for possibly auriferous quartz. On samples being assayed, however, gold was found to be absent and the material was considered to have no economic interest. Similar views were held concerning other deposits in the district, many of which have been known to prospectors for a number of years. Few prospectors in the district had any knowledge of the relations which jaspilyte has to iron ore deposits in other districts, and hence attached no economic importance to its occurrence.

The belt of interbanded jasper and magnetite which occurs north of lake Wahnapitae outcrops on a high hill. This hill can be seen from the lumber camps on the shore just west of the mouth of the creek which enters the lake near the eastern boundary of the Indian Reserve, and is about one mile north of the camps. The strike of the rock in the hill is somewhat south of east. The jasper and magnetite are cut by veinlets of quartz. Immediately north of this belt is a parallel band of highly quartziferous material impregnated with pyrite. The association of the jaspilyte and pyritiferous bands is similar to that in the more eastern part of the district which has already been described. The almost constant association of the two bands in this field is a somewhat striking feature and is worthy of more careful study than we were able to give it.

One half mile north of the shore of the lake a little west of the mouth of the Wahnapitae river another outcrop of jaspilyte occurs. The rock is pretty well covered with soil, but angular blocks of the material are strewn over the surface.

TOWNSHIP OF HUTTON.

The belt containing the lake Wahnapitae outcrops apparently extends northwestward in the direction of the general trend of the contact between the Laurentian and Huronian in this part of the district. Outcrops of jasper, both red and black, have been discovered in the Township of Hutton, the western boundary of which lies on the line between the districts of Algoma and Nipissing.

The writer did not visit the outcrops of the iron-bearing formation in this township, but through the courtesy of Mr. C. M. Boss of the Great Lakes Copper Company, and Mr. D. O'Connor, both of Sudbury, he has been supplied with information concerning them. They are stated to be situated in the the third, fourth, fifth and sixth concessions, and lie south of Clear lake. In concession V outcrops occur on lot 12 and stretch southward through the northeast corner of lot 12 in concession IV and into lot 11 in IV. In the first named lot the exposures lie from 10 to 30 feet above the surface of an adjacent stream.

Another line of outcrops is said to extend through part of lot 9 in V, 9 in IV and 8 in III. To the east of lot 8 in the concession IV there are said to be exposures of slate which is impreg-

nated with pyrite. Mr. Boss states that the strike of the beds of magnetic schist is about north 20 degrees west and that the dip is practically vertical. The width of the band is not known. Outcrops on lot 12 show a width exposed of about 150 feet and outcrops on lots 8 and 9 are 400 to 600 feet wide. Mr. Boss further states that the body of pyritous slate in lot 8, concession IV, strikes north 8 degrees east and dips 60 degrees south. Its width was not noticed.

Mr. O'Connor informs me that one way to reach this part of the township is to take a team from Sudbury to a point near the Vermilion river known as "Dawson City," to which there is a good road, the distance being 19 miles. From Dawson City there is a canoe route up by way of the west branch of the Vermilion river. Swift water is met with but it does not interfere greatly with the canoeing.

MORE NORTHERN OUTCROPS OF JASPILYTE.

Near the 61st mile post on the boundary between the districts of Algoma and Nipissing an exposure of jasper and magnetite was discovered in 1896, by Mr. E. M. Burwash, who thus describes it: "The creek flowing out of Shining Tree lake crosses the line about the middle of the 61st mile, and makes its way north and west to the Montreal river. A little over a mile north of the crossing the line touches the end of a bed of jasper which extends from this point (61 miles 53 chains) northwest for a distance of over half a mile. At the point where it is first met with the jasper rises in a low ridge from the soil of a swamp, and is in a comparatively solid condition. It is interbedded with thin seams of iron ore. Further north the ground rises and the band can be traced without difficulty. It is greatly weathered however, and its presence is indicated on the surface only by broken fragments of rock, so that it is impossible to say whether any considerable quantity of ore is contained in the jasper or not. At the widest point the bed is about 100 yards broad. On the line east of it the needle is deflected west 18 degrees, while the average variation for the locality is only about 7 degrees west. The jasper is red and black in color, often banded. The percentage of iron in a badly weathered specimen of the ore was 47.26.

"To the west of this jasper deposit the rock is apparently a somewhat coarse-grained diabase, followed after a short distance by a fine-grained ash rock, which becomes a conglomerate a little further west, containing fragments of jasper, granite and quartz. The strike of these beds is parallel to that of the jasper—namely about north 15 degrees west; the dip is to the west at an angle of about 75 degrees."[7]

The writer did not visit these outcrops, as Dr. Coleman had already examined them in the interest of the Bureau of Mines early in the season before we entered the field. As however they lie partly in the District of Nipissing it seemed well to mention them in this report so as to make the references to the occurrences of jaspilyte in the district complete.

Moreover about 80 miles almost directly east of the Shining Tree lake deposit there is another similar outcrop, which would make it appear that there is in the strip of country here stretching across the district a belt of iron-bearing rock similar to that which we have traced out during the past summer in the more southern part of Nipissing. The last mentioned outcrop lies northeast of the north end of lake Temiscaming and is described as follows by the gentleman who first examined it:—"The portage (the eighth from lake Temiscaming) is on the south or left hand side of the river (the Quinze) running in a direction about southeast to a small lake in a narrow ravine and is not more than a quarter of a mile long. The iron ore crosses the portage near the upper or south end. It occurs in the form of layers from the thickness of paper to about an inch, and is interlaminated with similar layers of whitish, gray and dull red fine-grained quartzite. The iron ore constitutes probably from a fourth to a third of the whole, and as the thickness of the whole band is about 30 feet, the total thickness of the layers of iron ore would probably not be less than 8 feet. The band was traced along the

[7] Bur. Mines, 6th Rep. 1896, pp. 174-5.

strike for about a hundred yards. Magnetic oxide of iron was observed under similar conditions at several points on this portage and on the next above but in much smaller quantity."[8]

Iron ore is stated to occur to the east across the Provincial boundary line, but the writer did not have the opportunity of verifying the reports. It is highly probable however that outcrops of iron ore associated with jasper do occur between the Quinze river on the east and Shining Tree lake on the west. The area intervening between these two outcrops has not all been geologically mapped. The geology of the greater part is known, however, and most of it is underlain by that member of the Huronian in which the jaspilyte is to be looked for.

Facilities for Shipping the Ore.

As regards the shipping facilities of the Nipissing ranges, the writer may refer to the proposal that has recently been made that the Ontario Government should construct a railway in the near future from North Bay station on the C. P. R. to the head of lake Temiscaming. Judging from the way in which the proposal has been received by the public it would appear that the district is assured of an outlet for its mineral and other products.

It is understood that the building of a canal from the Georgian bay by way of the French river to North Bay is also a live issue. If both the railway and canal are built these iron ranges of Nipissing will be better situated so far as shipping facilities are concerned than any of the great ranges whose outlet is lake Superior. The ores from Nipissing after a comparatively short rail haul can be loaded on boats and will reach lake Huron without having to pass through the congested Sault Ste. Marie canal.

Although, as already stated, no bodies of soft ore or hematite have up to the present been discovered in Nipissing, deposits of magnetite of considerable promise are known. The discoveries of bodies of soft ore outcropping at the surface in other districts of similar character are not numerous. This is not to be wondered at when we consider that they are much more easily worn down by agents of denudation than the harder magnetites and outcrops containing a higher percentage of rock matter.

If a number of ore bodies of economic value are not found in association with some of this jaspilyte, the Nipissing ranges will have to be considered as possessing a unique character, as no such extensive belts of similar character in which great deposits of ore do not occur are known in other districts. Of course much work may have to be done before the ore bodies are brought to light, just such work as has been done on some of the ranges to the south and west of lake Superior.

Other Minerals of the District.

A mispickel deposit known as the "Big Dan" lies a short distance south of Net lake. This mispickel is fine grained and massive in appearance, and occurs under different conditions from the well known deposits of Hastings county in the eastern part of the Province. Like that of the latter deposits however the mispickel of Nipissing is auriferous. As this deposit was described by Dr. Coleman in the last Report of the Bureau, p. 173, it is not necessary to refer further to it here. Mispickel is, as already stated, found in close association with the iron-bearing band at Austin bay, lake Temagami.

Reference has been made in this report to the fact that a pyrite-bearing belt of rock is almost constantly associated with the jaspilyte belt, the two running roughly parallel to each other at a distance of a half mile or less apart. At times the pyrite is represented by pyrrhotite.

As the pyrite is likely in the future to attract attention as a source of sulphur, a number of analyses were made of it in order to determine the amounts of gold and other materials which it carries. These would of course be considered as by-products in the working of the pyrite for

[8] Geol. Sur. Can. 1872-3 pp. 131-2.

sulphur, and some of them occur in proportion sufficient to be of economic importance. The following table gives the results of analyses of samples taken from deposits in various parts of the district examined. In most cases the samples contained considerable rock matter.

These analyses are all that were made of samples collected in the field. It is interesting to see that all the sulphides examined in the district carry gold, the precious metal in most of the samples being in amounts sufficient to be of value as a by-product in case the ores are used as a source of sulphur.

Number.	Weight of sample, ounces.	Gold value per ton.	Silver.	Copper per cent.	Nickel per cent.	Cobalt.	Platinum.	Sulphur per cent.
1.	13	$2.80	trace	00.31	00.34	trace	trace	28.47
2.	14	trace	nil	00.28	00.36	trace	trace	25.99
3.	18	trace	nil	00.91	00.31	....	nil	14.58
4.	14	1.20	nil	00.32	trace	....	nil	22.83
5.	20	3.40	....	....	....	....	....	3.57
6.	10	1.20	trace	nil	nil	nil	nil	35.91
7.	....	1.70	trace	nil	nil	....	....	....
8.	20	2.00	trace	nil	nil	nil	nil	30.31
9.	33	1.40	nil	00.48	00.27	....	nil	26.20
10.	....	1.80	trace	nil	trace	....	....	....
11.	10	1.20	trace	nil	....	....	....	....

Sample No. 1 was composed chiefly of pyrrhotite and was taken from a deposit lying a short distance west of James lake.

Nos. 2, 3 and 4 were composed essentially of pyrrhotite taken from deposits lying a short distance south of Net lake.

No. 5 was a rusty sample of quartz from the same locality.

No. 6, from the south of O'Connor lake is from the pyritous band which as stated in preceding pages parallels the jaspilyte belt in that vicinity and was made up, for the most part, of pyrite.

No. 7, was chiefly dark quartz, from south side of the jaspilyte band, 3 miles east of Kokoko lake.

No. 8 was essentially of iron pyrites, from the band on the south shore of Vermilion lake.

No. 9, iron pyrites with intermixed rock matter from the south shore near the eastern extremity of the north east arm of lake Temagami.

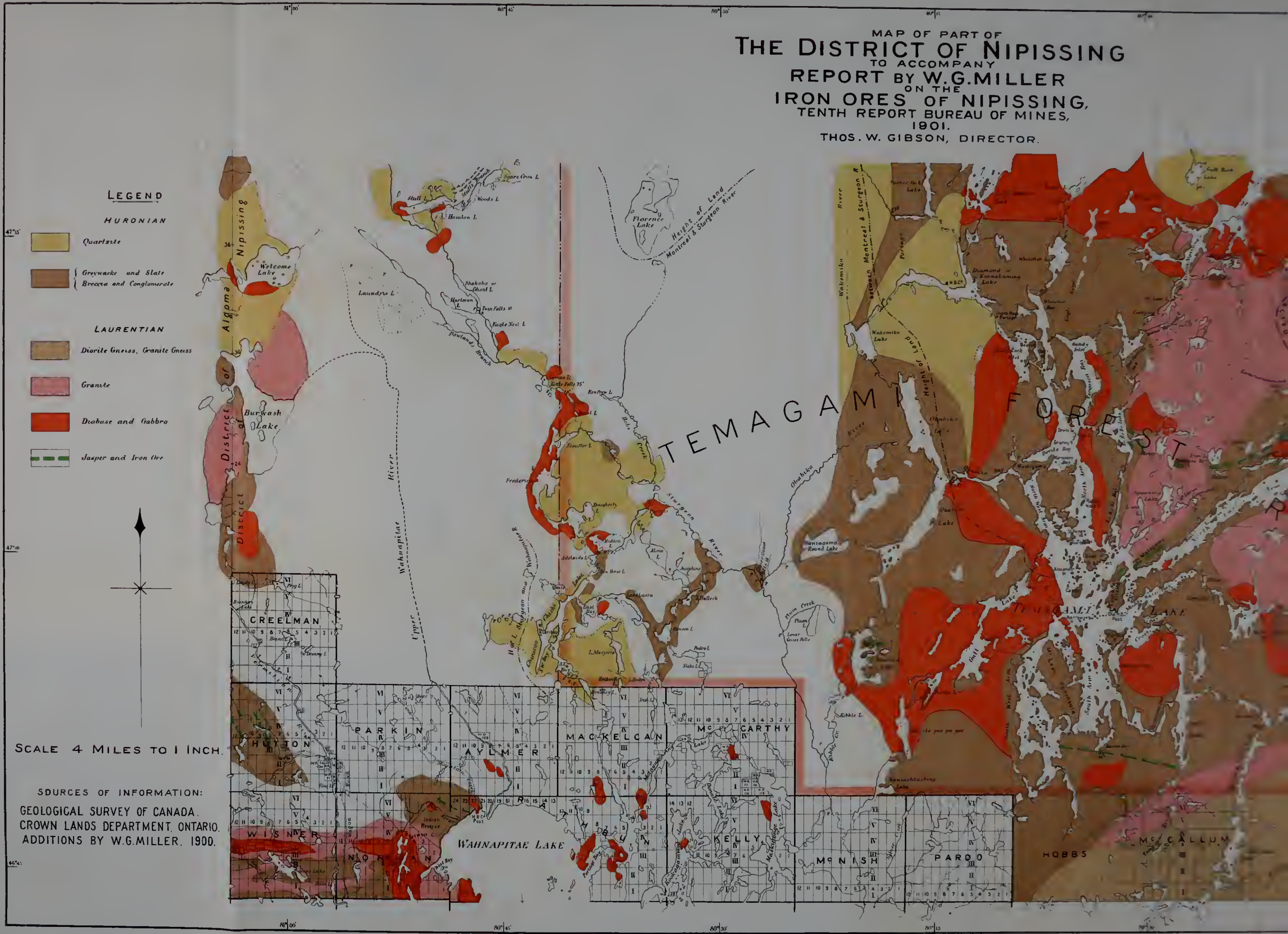
No. 10, rusty quartz, and pyrite from near the "vug" on Emerald lake.

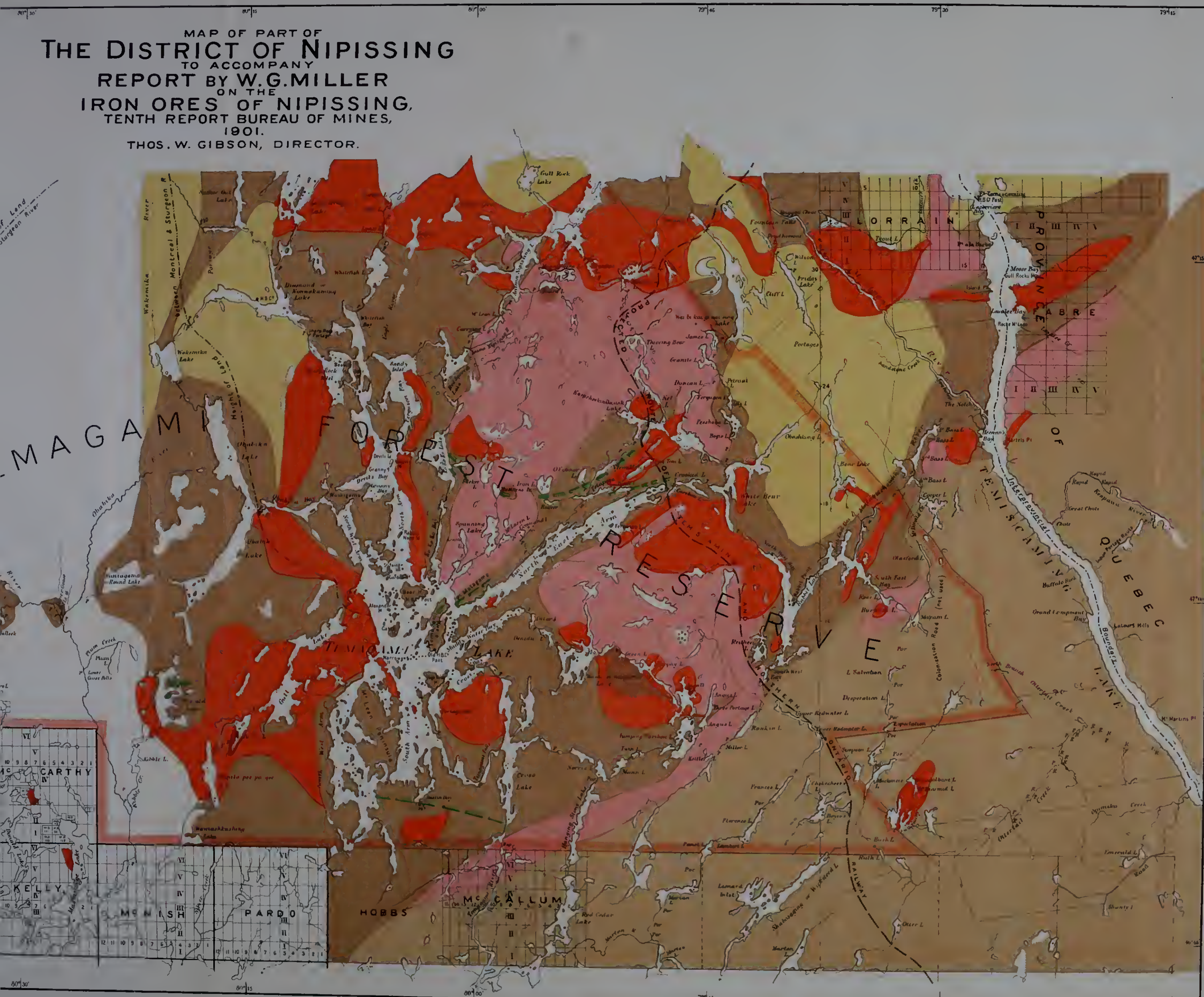
No. 11, from a prospect on the large island in the same lake.

Galena occurs at various points in the district. A deposit of this mineral is being mined on the Quebec side of Lake Temiscaming to the north of the village of Ville Marie, and the product obtained after concentrating the ore is shipped to England to be refined.

A deposit on an island in Cross lake which lies south east of lake Temagami was visited by my assistant who collected specimens from it. The ore consists of galena and copper pyrites in quartz. An analysis of this ore showed it to contain the following materials of economic value, the values of each being stated in dollars per ton of two thousand pounds ; gold $2.00, silver $9.20, copper $4.20, lead $4.00.

All the assays and analyses referred to in this report were made by Mr. J. Walter Wells B. Sc., assayer to the Bureau of Mines.


MAP OF PART OF
THE DISTRICT OF NIPISSING
TO ACCOMPANY
REPORT BY W.G.MILLER
ON THE
IRON ORES OF NIPISSING,
TENTH REPORT BUREAU OF MINES,
1901.
THOS. W. GIBSON, DIRECTOR.
LEGEND
HURONIAN
Quartzite
Greywacke and Slate
Breccia and Conglomerate
LAURENTIAN
Diorite Gneiss, Granite Gneiss
Granite
Diabase and Gabbro
Jasper and Iron Ore
SCALE 4 MILES TO 1 INCH.
SOURCES OF INFORMATION:
GEOLOGICAL SURVEY OF CANADA.
CROWN LANDS DEPARTMENT, ONTARIO.
ADDITIONS BY W.G.MILLER. 1900.
TEMAGAMI FOREST
District of Algoma
District of Nipissing
Welcome Lake
Burwash Lake
Florence Lake
Height of Land
Montreal & Sturgeon River
Wahnapitae River
Upper Wahnapitae River
Sturgeon River
Wakemika Lake
Obabika Lake
Diamond Lake
Temagami Lake
Wahnapitae Lake
CREELMAN
PARKIN
AYLMER
MACKELCAN
McCARTHY
HUTTON
WISNER
NORMAN
RATHBUN
KELLY
McNISH
PARDO
HOBBS
McCALLUM


MAP OF PART OF
THE DISTRICT OF NIPISSING
TO ACCOMPANY
REPORT BY W. G. MILLER
ON THE
IRON ORES OF NIPISSING,
TENTH REPORT BUREAU OF MINES,
1901.
THOS. W. GIBSON, DIRECTOR.
TEMAGAMI FOREST RESERVE
PROVINCE OF QUEBEC
TEMISCAMING
LORRAIN
FABRE
McCARTHY
KELLY
McNISH
PARDO
HOBBS
McCALLUM
TEMAGAMI LAKE

IRON RANGES OF THE LOWER HURONIAN.

BY A. P. COLEMAN.

After examining the Meteor lake placers we turned northwards towards Matagami Post and Shining Tree lake, passing through Seven Mile lake to the Matagami river, and then by a series of small lakes to Matagami lake, the object in view being the examination of the iron ranges reported to exist in this region, beginning with that near Shining Tree lake, and ending with the ranges near Sault Ste. Marie, Batchawana bay and Michipicoton, the latter including the Helen mine.

The courtesy and assistance almost always met with in the field from mining men and others was encountered on the present occasion, but to Messrs. Clergue and Professor Willmott special gratitude is due for aid and information in connection with the Michipicoton iron range.

It need scarcely be said that the maps and reports of the Geological Survey of Canada have been of the greatest service for reference in the field and in preparing the report ; and that the reports of the United States Geological Survey and those of Minnesota have been most useful in studying the iron ranges, since their territory covering very similar deposits has been carefully studied and mapped.

Seven Mile is a brown water lake, unlike the clear bodies of water found in the gravel region at the height of land. After the portage north from Meteor lake comparatively little gravel or sand is seen for some time, though some gravel benches occur toward the north of Seven Mile lake ; but gneiss and granite crop out at the northeast end where the river flows out at the first rapid, and where there is a fall of 2 feet over granite. The second, a quarter of a mile below, shows Laurentian gneiss with some dioritic streaks on the portage.

Canoeing Down the Matagami.

This part of the river has low shores, generally of muskeg covered with small spruces, and neither sand nor gravel terraces ; and the narrow lake expansion below, though with rockier shores, is of the same general character. Then come swift currents over boulders and gravel, with navigation somewhat hampered by fallen trees, followed by a portage over granite past a small rapid. A few small rapids and one with a fall of about nine feet lead to a comparatively large expansion, Napawquazi lake, from the northern end of which the usual canoe route leaves the river. There are a few sand terraces, one 40 feet high, on the shore of this fine lake, but we found no gold colors in the sand. On the west side there is a small clearing with a deserted shanty, probably belonging to Indians.

A portage about two-fifths of a mile long leads to Waaongo lake, which is about three miles long and has some sand terraces rising above it to a height of from 20 to 60 feet, with gravel occasionally at the foot. We found only a single color in a pan of this gravel, but plentiful black sand. A portage of a quarter of a mile over a hill of sand and gravel brings one to a pond half a mile long, which appears to stand about 100 feet lower than the previous lake. Most of the shore consists of a steep and high slope of sand and gravel, and the pond has no visible inlet or outlet. At the northwest corner there is an outcrop of hornblende chlorite schist having a strike of about 120 degrees and a steep dip to the northeast. Around this lake there is a belt of red pine, and this tree with an occasional white pine was found to some extent on the two previous lakes, but none of the timber is large.

A mile and a third of portage leads northwards to lake Matagami, first with a steep climb to the top of what seems to be a gravel plain, then with more or less undulation a steady slope down to Matagami, which our aneroids made 50 feet lower, or about 1080 feet above the sea. No rock was seen on the portage, only loose materials, and apparently some one had dug test pits at one or two points. Gravel from one of these a quarter of a mile south of Matagami is

very like that of Meteor lake, consisting mostly of granite and gneiss pebbles with a considerable number of Huronian pebbles and a little red slate, but with few or no colors of gold.

The most southerly bay of lake Matagami has a shore of green schist conglomerate, striking 50 or 60 degrees and with a nearly vertical dip, where the portage reaches it. The pebbles contained in it are large and consist as far as seen of felsite and granite, the whole somewhat sheared. To the north along the west side of this very straight reach of the lake, as mentioned by Dr. Parks in last year's report,[1] Laurentian granite and gneiss alternate with Huronian rocks striking generally about east and west, though with some variations, and dipping from vertical to about 80 degrees to the south. Gravel occurs with sand and silt about two and a half miles up the lake, resembling that of Meteor lake, but we found no colors in three panfuls of it. Apparently the gravels north of Meteor lake are much poorer in gold than those on its shores and to the south.

MATAGAMI LAKE AND EASTWARD.

As Dr. Parks has briefly described Matagami lake and post little need be said of it here. Mr. Miller, the Hudson Bay Company's officer, gave us useful information and procured a guide for Shining Tree lake. It seems that only about ten families of Indians are left in the vicinity of this post, a great falling off from earlier years, and that the output of furs has greatly decreased also. The post now gets its supplies from Matagama on the Canadian Pacific ; but formerly sent its large canoes, one of six fathoms carrying 4,200 lbs., down the river to Moose factory for everything needed from the civilized world.

The route to Shining Tree lake turns off to the east from Lake Matagami about seven miles south of the post, a portage of about two and a half miles leading across sandy plains mainly covered with small jack pine. Part of the path lies on a sharp sandy ridge, probably an esker. A small pond followed by the ascent of a rapid creek for about a mile and a half bring one to a lake three or four miles long named Wabasistagenda, shallow and muddy for a mile, then of deeper clear water. The rock at the pond and on the lake is Huronian, green schist and weathered diabase in general ; and green slate or schist on the lake was found to strike 70 degrees with a dip of 80 degrees to the north, while agglomerate appears on a point near the portage to the southeast. The portage is about one mile and a quarter long, largely over muskeg on which poles have been laid down, and leads to another part of the creek mentioned before, after which there is a short portage to a lake belonging to the waters of Montreal river. Sausuritic rock, green slate and diabase are the rocks occurring. The next lake, called Nishikowgenda, is a narrow and intricate body of water, followed by the canoe route for about six miles ; after which comes a short portage into a little lake and then into Montreal river, or one of its upper branches. The only rock seen on the river was granite, which crops out here and there ; but low sand plains form the banks of the river, which has a rather swift current and is very crooked. Turning off on a creek to the east there is a portage three-fifths of a mile long, into the first of two small lakes, and of a quarter of a mile from the second into Shining Tree lake as it is named on the map of Niven's line. Our Indian states that its real name is Biogskuaga, and that the name of Shining Tree, or "bare white" tree belongs to one of the smaller lakes passed through on our journey. Probably it is better to leave the name as it now appears on the maps.

JASPER AND IRON ORE AT SHINING TREE LAKE.

When Niven's line was run Mr. E. M. Burwash, who accompanied the party as geologist, examined as fully as time would permit the rocks occurring on Shining Tree lake and called attention to the jasper deposit where the line crosses the stream flowing out of the lake, about a

[1] Bur. Mines, 1900, p. 127.

mile and a half northwest of it. From a crevice in the jasper he obtained porous impure red hematite, one specimen of which assayed 47.26 per cent. of iron.[2] The occasion of our visit to the lake was to trace out the jasper band as far as possible and work up the geology of the associated rocks. Mr. Burwash's work was accurate, and the present account simply adds to what he has reported of the region. As he states, the jasper rises out of the swamp where crossed by the line, at mile 61 and 53 chains, may be traced toward the northwest, and is about 100 yards wide at the widest point. It was a singular chance that the line struck the jasper at all, for if it had passed a hundred yards to the east or the west the iron belt must have been missed.

The jasper is not very bright red and merges into cherty looking material, but both are more or less interbanded with magnetite, and the whole mass affects the compass considerably. The belt trends north 40 degrees west and can be followed for a mile in this direction over fairly high ground, by the broken cherty fragments on the surface. This brings it to the swampy shore of the creek flowing out of Shining Tree lake, and beyond the wide marshy valley it was not found again, though two excursions were made inland ; the only rocks seen being agglomerate or slate rising as narrow ridge-like hills out of the swamp.

To the south of the point where the jasper was found on the line the region is very swampy as a rule, but outcrops were found in various places. A quarter of a mile in the direction of the jasper on the line south 17 degrees east cherty ore occurs again, having the strike just mentioned and a dip of 75 degrees to the west. About where the creek crosses Niven's line, just north of Shining Tree lake, a tributary comes in from the east ; and half a mile beyond the line and somewhat to the south of the tributary many large blocks of jasper occur on a hillside. Though not seen in place the blocks are so numerous and angular that they cannot have travelled far and probably are in place, beneath the soil. Still farther to the southeast (south 20 degrees east) jasper shows itself at various points for a distance of a mile and a half, and one outcrop can be followed for about 300 yards, where it has a width of at least 60 feet, the boundaries however being somewhat covered and uncertain. Here it has a dip of about 45 degrees to the west. Along this portion of the belt the jasper was of a very rich color, bright red banded with purplish red and with iron ore, the latter appearing to be magnetite and less often limonite, not hematite so far as observed, though this occurs farther north where the range crosses Niven's line. No ore of value was found, but very little stripping was done and the swampy and wooded character of the country made examination difficult. The belt was traced with fair continuity for about 3½ miles, being lost in swamps at each end ; and it is found to curve from a direction of south 40 degrees east toward the north to south 20 degrees east or even south 17 degrees east toward the south. A continuation of this curve to the southward would come out about at the southern end of Shining Tree lake, and close search was made for it here with the result that large, angular blocks of jasper were found, but none in place. South of the end of the lake the region is for a long distance low and swampy, and two excursions, one to the east and the other to the southeast, though crossing rocky ridges, disclosed no jasper. If we suppose the jasper to continue to the southern end of the lake where numerous blocks of it occur, the whole length is six and a half or seven miles.

GEOLOGICAL RELATIONSHIPS OF THE JASPER

Mr. Burwash noted that to the west of the jasper band, where found north of Shining Tree lake, there is a somewhat coarse diabase, followed after a short distance by a fine grained ash rock, which becomes a conglomerate a little farther west, containing fragments of jasper, granite and quartz. The strike of these beds is parallel to that of the jasper, about north 15 degrees west ; the dip is to the west at an angle of about 75 degrees. Similiar relationships were found by us at other points, diabase, agglomerate and a slaty ash rock occurring to the west of the

2 Bur. Mines, 6th Rep., 1896, pp. 173-4.

jasper range farther south, and conglomerate still farther west on islands in the lake. Immediately underlying the jasper there is a slaty rock, much sheared and slickensided in places ; and interbedded with the jasper at one point there is a gray fine-grained rock, seemingly an impure siderite, which weathers into red and brown iron ore and somewhat resembles the carbonate found at the Helen mine. The nearest rock toward the east after the slate is diabase which runs as ridges with lower ground between.

The conglomerate west of the jasper band evidently belongs to the Upper Huronian, since it contains pebbles of jasper and chert. It is well exposed on two islands in Shining Tree lake, where weathered surfaces show admirably the pebbles and boulders, sometimes reaching a longest diameter of 2½ feet, and consisting of a great variety of rocks, including coarse red granite, quartz porphyry, felsite, felsite schist, light and dark green schists, slate, jasper, and chert. The last two varieties are not very common, though they may be found at most exposures of the conglomerate; and only one boulder of gneiss was seen and also a single boulder of diabase. These pebbles and boulders are generally well rounded, but sometimes subangular, and the matrix has the nature of arkose, not of schist. The rock strikingly reminds one of the basal conglomerate of the Upper Huronian on islands east of Thessalon in the typical Huronian regions. No distinct bedding is seen in this conglomerate, so that its strike and dip have not been determined. Between these islands and the conglomerate described by Mr. Burwash no rocks of the kind were found, but mainly slate, agglomerate, diabase and diabase porphyrite. Mr. Burwash found also an amygdaloidal rock, and it is probable that near the northern end of the lake these eruptives have broken the continuity of the conglomerate.

At the lower end of Shining Tree lake, flat lying brownish arkose forms the eastern shore rising as a steep hill capped by coarse-grained diabase. The sandstone or arkose which dips about 10 degrees to the southwest so far as can be told, and rises 67 feet above the water, with a covering of diabase having a thickness of about 45 feet, contains a few jasper pebbles and some of white quartz, and occasionally has cross bedding. Whether it overlies the conglomerate found on islets in the lake to the west is uncertain, though probable. The southwest end of the lake shows only diabase and a slaty rock breaking into small cubes, while the extreme south end is margined with swamp which extends as far as can be seen in that direction.

In case the jasper band turned off to the southeast, the country east of Shining Tree lake was explored and found to be much intersected with lakes, the first one reached by a mile's portage from the large bay on the lower end of the lake. Only diabase was seen on the trail, which is swampy at first and afterwards dry and wooded ; but quite varied rocks occur on the four lakes examined, including gray schist, finely banded slate lying nearly flat, coarse conglomerate, probably underlying the slate, and several masses or ridges of diabase cutting the other rocks. On the portage between the two most northern lakes a small boss of red granite pushes up through the Huronian rocks. No jasper was seen, and it may be that the rocks observed are all Upper Huronian, the Lower Huronian being covered by the flat lying slates. From the great variation in strike and dip of the stratified rocks on and near Shining Tree lake, as well as the great nnmber of eruptive masses, we may conclude that the region has undergone many vicissitudes and that the tracing of a given band of rock, such as the jasper, for any great distance may prove impossible. The drift deposits of the Shining Tree lake region are unimportant in amount, so that the solid rock, when it rises above the general swampy surface of the country is fairly well exposed. Glacial striæ occur at several points, running from 7 degrees east to 10 degrees west of north.

EXPLORING REGION AROUND SHINING TREE LAKE.

In order to explore the country to the northwest of the jasper outcrop we returned to Matagami by another route, little frequented, so that we had to cut out portages, but on the whole as good as the one used when coming in. Following down the sluggish stream draining Shining

Tree lake, which flows in a general way toward the northwest, we found that it winds for about ten miles through a wide swampy valley with only a few outcrops of rock within reach of canoes, at first rocks of the character previously described ; but after five or six miles two points of Laurentian looking red syenite occur. A portage of three fourths of a mile leads over into Montreal river and a chain of small lakes connected with it, where the rocks appear to be Huronian again, chiefly fine gabbro and diabase, but sometimes slate, in one place striking about north and south with a dip of 80 degrees to the west. A little farther to the west the strike was 110 degrees and dip vertical.

The route from Matagami to Temiscaming, which we followed for some distance, has been disused for ten years or more, so that the portages are badly grown up. It does not follow Montreal river for more than a short distance but turns aside through a series of small lakes to avoid rapids, and finally reaches lake Nishikowgenda, which we had traversed on our way into the region. The rest of the route to Matagami has therefore been described.

No trace of the jasper band was found to the northwest of the Shining Tree lake region, and the only hint of its existence elsewhere in this part of the country is the statement of our Indian guide that he had seen the same rock on a point in She-bine-agung lake, which is a day's journey with six portages to the northeast of Shining Tree lake. On being shown the map he thought Duncan's lake, or as it is marked on the latest map of the region Pigeon lake, one of the upper expansions of Montreal river, was the one.[3]

Leaving Matagami post we followed the route used by the Hudson bay canoes, through Minnesinaqua and Muskegogema lakes to the height of land, and then down a chain of lakes tributary to Spanish river, thus reaching Matagama station on the Canadian Pacific railway. As this route was followed by Dr. Parks in 1899 and a brief account of the geology is given in his report,[4] all that is necessary here is to mention certain special points. The sand and gravel deposits at the height of land resemble those of Meteor lake in some respects, though sand is more prevalent and the gravel seems lacking in the small amount of clay generally found in the more auriferous portions of the Vermilion placer region. The wide sand and gravel plain contains a few clear water lakes, one without an outlet, and has the same general character as the height of land further east. The sand terraces continue after Spanish river waters are reached, and in fact do not cease until a few miles from the railway, in some places the banks of the creek or its narrow lake expansions, consisting wholly of sand and gravel and rising as much as 115 feet ; but no gold was found on panning at any of these points. These gravels, though containing pebbles of Laurentian and Huronian like those farther east, seem to have been derived from a different and less auriferous region.

Iron-Bearing Rocks of Clear Lake.

As iron-bearing rocks similar to those of Shining Tree lake had been reported from Clear lake in Wisner township about 20 miles north of Sudbury, and it was thought that these might be a continuation of the band described in previous pages, an excursion was made to the point. The route is the same as that to "Dawson" on the Vermilion river, but after reaching the river it turns off to the northwest, at first by a lumber road, but afterwards by a succession of small lakes and streams beginning with Joe's lake or Marion lake as it is called by some, which is about 3 miles long, trends northwest and southeast, and is enclosed in grano-diorite, except for a small portion of Huronian at the southeast end. Just north of Joe's lake the diabases of the nickel belt run east and west, and the part rising above the swampy ground, here quite narrow, only about an eighth of a mile wide, is all taken up as mining locations. A hilly and crooked portage leads over the range to a succession of ponds or small lakes connected by a slug-

[3] Jasper is reported by one of the Ontario Government Exploration parties on the east branch of Montreal river, about 16 miles northeast of Shining Tree lake.

[4] Bur. Mines, 1900, pp. 125-127.

gish stream, and the iron-bearing rock occurs just south of the next larger body of water, Clear lake. The general rock of the region north of the nickel belt is a coarse grained Laurentian looking granite and is mapped by Dr. Bell as Laurentian, but occasionally small strips of green schist and other Huronian rocks occur in the granite, and at one point near a fall on the creek a small area of schist conglomerate is found, containing pebbles of granite and other rocks enclosed in a green chloritic matrix. The largest patch of Huronian schist is just south of Clear lake, between it and a small lake.

MAGNETITE IN QUARTZITE

The iron-bearing rock is not jasper but has a quartzitic look and is interbanded with magnetite, so that the compass is much affected in its vicinity. It occurs on the eastern shore of the little lake just mentioned and runs with interruptions about east and west, though some parts differ in strike from others. About an eighth of a mile east of the little lake it seems to turn nearly south; and small patches of the material may be found for about three-eighths of a mile in that direction, in most cases the banded rock being much contorted and faulted, and having a very high dip. The greatest width observed was about 24 feet, and the bands were nowhere traceable for much more than 100 feet. They are often accompanied by weathered diabase or finely banded gray or green schist. As ore deposits they are of no importance, too much silica being intermixed with the magnetite ; and the presence of iron pyrites still further lowers the quality. There is no doubt, however, that these fragmentary bands are the equivalent of the sandstone or jasper belts of Michipicoton, Shining Tree lake, etc. ; but one may suppose that only remnants of the deposit remain imbedded in the granite, the upper portions with other softer Huronian rocks having been eroded away. It is of interest to find here also a remnant of the basal conglomerate of the upper Huronian.

Entirely similar bands of silicious iron ore are found about three miles west of Clear lake, probably an extension of the bands described, and of no more importance. An apparently more valuable set of deposits occurs in Hutton township, the next to the north, as I was informed by Mr D. H. Terry after leaving the region, where magnetite with some jasper runs for about four miles and so continuously that one can walk on ore for half a mile. The deposit is stated to run north and south ; but as the most southerly point is on the south half of lot 8, con. III, and the most northerly on the south half of lot 12, con. VI, either it must run diagonally or possibly there are two bands, as in some other regions.

The country rock is said to be granite on the west and diorite on the east, but in one place on the south end of lot 8, con. IV, the ore cuts through a hill of granite, which reminds one of the bands of silicious magnetite described above from Wisner township.

The Hutton ore belt is probably an extension of the jaspery magnetite found in Norman township east of the point where Wahnapitae river enters the lake of the same name ;[5] but as it was intended that this part of the region should be reported on by Professor Miller we did not follow the matter up.

The only other suggestion of jasper deposits in the district appears to be the finding of jasper conglomerate by Mr. Stull on a small lake cut by Niven's line not far from mile 23, about 15 miles north of the Hutton iron ore. As jasper conglomerate, though belonging to the basal beds of the Upper Huronian, is generally found not far from the Lower Huronian jasper band which supplied the pebbles, it is probable that the iron-bearing rock may be found in the neighborhood.

The region is on the whole a troublesome one to explore, since the canoe routes are unusually poor and infrequent for northern Ontario, and high rocky ridges with much fallen timber make travel by land very laborious.

[5] Bur. Mines, 1897, p. 141.

Jaspery Ores Northwest of Sudbury.

Jasper and iron ore have been reported at several points northwest of Sudbury. and as many of them as could be definitely located were visited by myself or my assistant, Mr. Kay. A deposit of iron ore occurs west of Geneva lake in intermixed Laurentian and Huronian rocks, but no jasper, chert, quartzite or sandstone occurs with it, so that the deposit cannot be classed with those we were specially to investigate. There is a conglomerate, probably basal Upper Huronian, at Geneva lake, containing boulders and pebbles of granite, felsite, greenish schist and quartz ; but none of jasper or other materials suggesting the proximity of silicious iron-bearing rocks were found.

Jasper with ore has been reported also from lake Onaping. being said to occur on a bay to the west, and we found jasper conglomerate as boulders at the outlet of the lake and at the narrows, while the same rock occurs in places on a small island in a little bay just northwest of the narrows. The boulders are mostly granite, but include many other rocks as well as pebbles of jasper and of black chert. The rock strikes from north to 20 degrees east of north and has a vertical dip. The conglomerate is very like the Huronian "slate" conglomerate of Echo lake described by Logan and Murray. While the jasper pebbles suggest that the iron-bearing rock is near, it was not found by us in the short time we could devote to the work.

Jasper of a good red color associated with magnetite occurs on a long ridge to the east of lake Onaping, between it and Meteor lake, as reported by Mr. J. F. Whitson of the Crown Lands Department. It lies three and a quarter miles east of the north end of Onaping, and runs about northwest and southeast parallel to a deep valley occupied by a tributary of the Matagami, so that it is just on the height of land. The rocks enclosing it are gneiss, and the region is reported by Mr. Whitson to be Laurentian, which reminds one of the association at Clear lake, though the deposit seems much larger and more continuous than the latter. Gold also is reported from two points by Mr. Whitson, one just north of lake Onaping, the other 5 or 6 miles northwest beyond the height of land, at the southern end of Donnegana lake.

It may be added that jasper is reported to occur at some points far to the north, *e.g.*, at Night Hawk lake ; but it was impossible for us to examine this region in the time at our disposal, and in any case search for a small outcrop in a badly mapped region without a guide is very unsatisfactory.

Jasper is said to have been found some miles north of Woman river, but as no definite information could be obtained regarding it and no guide could be found it was not visited. It has been reported also north of Biscotasing, associated with impure iron ore, but we could not obtain a guide in this region either.

Iron Ores Near Sault Ste. Marie.

As the country between the last points mentioned and the Sault, as well as the Michipicoton region, is mapped as Laurentian it did not seem advisable to spend any more time upon it, and we went directly to Sault Ste. Marie, where deposits of the sort were said to occur at several places.

Seven or eight miles north of the "Soo" on a lumber road leading to Irwin and Gray's lumber camp a deposit of silicious iron ore has been opened up to some extent by Mr. J. B. Miller, disclosing cherty or quartzitic looking material interbanded with magnetite in the usual way. The large amount of the latter mineral makes the compass useless, but as judged by the sun the band strikes about 20 degrees west of north, though as it is much contorted and penetrated by granite the direction is far from uniform. The dip is about 50 degrees to the east. The deposit is not large, and seems too silicious to be of use as ore ; and from the fact that the surrounding rock is a granite of Laurentian aspect, the probability of finding richer ore at this spot is not great.

While this particular point seems on the margin of Laurentian and Huronian, since the granite contains besides the chert, strips and masses of green schist, undoubted Upper Huronian conglomerate occurs not far to the north on the same road, but separated by a deposit of drift materials. The conglomerate extends for three-quarters of a mile and consists of coarse, sandy looking quartzite often thickly crowded with rather small pebbles of granite and white quartz, but no pebbles of chert or jasper were seen. The Laurentian rocks near the magnetite strike about east and west and dip 45 degrees to the north ; and these directions are found also in the conglomerate to the north. A mile to the south the rock looks Laurentian, strikes about 60 degrees east of north and dips steeply to the northwest.

The silicious iron ore from this locality resembles very closely that from Clear lake north of Sudbury ; and it seems that the contact with Laurentian granite or gneiss gives rise to this glassy quartzitic or cherty rock interbanded with magnetite, instead of the sandy or jaspery variety with bands of hematite often found in larger areas of the lower Huronian.

The other iron ore deposits near the " Soo " proved to be of a quite different character, but may also be described. The road to one of them starts from Desbarats on the Soo line and runs northeast to Aberdeen Additional. Near Desbarats is the Cameron copper mine where some work has been done on a vein containing chalcopyrite and chalcocite in quartz, an ore resembling that of the Bruce mines. The country rock however is different, being in general red quartzite as mapped by Logan, really a silicified arkose, though near the vein the color is changed to gray, the felspar being decomposed by the circulating waters. A car load of rich ore is said to have been shipped from here, but the mine was shut down and no one was at hand to give information regarding it.

IN ABERDEEN ADDITIONAL.

Red jasper pebbles occur in the same arkose somewhat farther north, causing Murray to map it as jasper conglomerate ; but about six miles from the river green or sometimes purplish slaty rock, very compact and often flinty looking occurs, with a dip of 25 or 30 degrees to the southwest, and continues to seven or eight miles from the river, though interrupted by some hills of rudely columnar diabase. On lot 6, con. III of Aberdeen Additional there is a white quartzite, unusually distinctly stratified, often crossbedded, with a strike of about 120 degrees and a dip of 20 degrees to the southwest, containing at some points jasper pebbles, and occasionally stained red with earthy hematite and thin seams of specular hematite. On lot 5, con. IV, one finds bands of the quartzite thickly sprinkled with pebbles of jasper and white quartz ; but on lot 9, con. V, of Meredith the rock is purplish gray graywacké with slaty layers, striking 100 degrees and dipping nearly vertically. A vein of purplish quartz runs parallel to the bedding, and a few test pits show that thin seams of specular hematite occur in it.

On the south half of lot 3, con. V of Aberdeen Additional there is dark purplish quartzite or arkose seamed with small veins of quartz and also of reddish specular ore ; and on the north half of lot 3, con. IV, there is some fairly good hematite, apparently cementing a brecciated band of rock, having a strike of 100 degrees and a dip nearly vertical. A little to the east of this on lot 2 there is a vein about two feet thick of very pure specular ore, partly concretionary, in a slaty rock with a strike of 105 degrees and vertical dip. Some of this ore is of excellent quality so far as can be told without an assay, but the small amount of work done on the deposits is not sufficient to prove the presence of large bodies of ore.

From the description given it is evident that these iron deposits are of an entirely different character from those hitherto described and belong probably to the Upper Huronian. Hematite deposits of a similar kind occur to the north of this in Chesley township near Island lake east of the mouth of Echo river.

The rocks referred to as associated with iron ore in Aberdeen Additional are mostly ver-

tical, an unusual feature in the Huronian of the region, but this seems to be quite local, since to the southeast and south the dip, at first 65 degrees to the southwest, becomes flatter until it is not more than 5 or 10 degrees, and still further south begins to dip gently the other way, toward the northeast, evidently forming a shallow trough running from southeast to northwest.

Jasper near Batchawana Bay.

The next point toward the northwest at which jaspery iron ore has been found is near Batchawana bay, and although quotations describing it were made from Messrs. Macfarlane and J. A. Holmes in last year's report [6], it was thought wise to go over the ground again, since the reports were not full and did not seem to agree in their statements. It was found in the field that both were correct as far as they went, and that there are in reality two quite different bands of silicious iron ore, thus accounting for the discrepancies of the two descriptions.

The nearer to the bay of the two bands of iron ore was many years ago taken up for mining purposes, as shown on the Crown Lands map, where eight lots in two rows run westward from Batchawana river three or four miles north of the bay in the township of Palmer. The four lots on end give a length of about five miles, and in all probability more or less ore was found on the whole length. That the property was looked upon as valuable is proved by the fact that the grading for a railway was completed from the bay to a point on the iron range, though the rails were never laid. The old grade, though somewhat grown up with bushes, offers much the best route to the iron range, which lies in a region mapped by Logan and Murray as Laurentian. Probably, however, it had never really been studied by those excellent observers, or it would have been colored differently. The railway grade runs through drift, mostly sandy, and the first rock is seen near the Batchawana mine, where the grade ends at the old camp, nothing of which now remains but a single burnt building and a small clearing on which a seedling apple tree was in fruit on July 8. Notwithstanding that so much work had been done in grading the railway, very little mining seems to have been carried on, though numerous test pits and one or two open cuts were made in the long ridge of rock with which the jasper is associated.

North of the camp a rocky ridge ascends steeply, the highest point, which consists of diabase, rising 233 feet above the plain. Near a small burnt building, perhaps a powder house, a small amount of work had been done, showing dull reddish jasper with little ore; and in the cliff above there are two beds of the jasper, each about six feet wide, separated by twenty feet of the gray green schist, which forms the slope of the hill. The upper bed strikes about 70 degrees and has a dip of about 70 degrees toward the north, or into the hill. Somewhat to the west of this on top of the hill a shaft, now full of water, had been sunk on jasper, which is here about 40 feet wide and has chlorite schist as the country rock on the northern or upper side.

At a point two miles east or a little north of east of the camp and a half mile from Batchawana river is the most easterly opening, where the hill is comparatively low and heavily covered with hardwood forest so that the associated rocks were not well disclosed, though much jasper with some hematite and magnetite could be seen. At an opening to the west of this the strike was about east and west but the dip was only 50 degrees to the north, while the only country rock to be seen was diabase. As the work was done twenty or more years ago many of the smaller openings are hidden by the undergrowth.

There is little ore of value to be seen, as suggested by Mr. Macfarlane, and what there is seems mostly lustrous hematite, blue ore like some of that from the Jackson mine, Michigan. As in that mine, the jasper has undergone dislocations since it was formed and is in lenticular bands, sometimes brecciated, with the fissures filled with specular hematite, which must have been deposited later than the jasper.

[6] Bur. Mines, 1900, pp. 161-3.

As jasper occurs on the banks of the Batchawana near its falls, about 7 miles up according to Mr. Thos. Bishop, and similar banded rock is reported by Mr. Pete Jones, of Batchawana, from Pointe aux Mines, about 18 miles northwest of the bay, and also from about 8 miles up the Harmony or Chippewa river, jasper-iron deposits must be widely distributed in the region.

THE VULCAN AND MAMMOTH LOCATIONS.

The other set of locations called the Wilson or Vulcan and the Mammoth properties lie to the north of Palmer township and are about nine miles in a direct line north of the wharf on Batchawana bay where the railway ends ; but by the trail, which follows the railway grade for three miles and then winds through the woods, the distance is about eleven miles, passing the high hill used as a signal station by the United States Hydrographic Survey. The first half of the road is good, being mostly across old sand and gravel terraces with little rock : but the latter part crosses morainic and rocky ground with some muskegs and is distinctly bad. The whole region is covered with forest, mostly of deciduous trees and especially maple.

The iron-bearing rock is first met on section 5, of Palmer township, just to the southeast of the Wilson location. Here one finds a band of quartzitic looking material interbanded with magnetite on a steep hillside. The band is about ten feet wide and is visible for 100 feet where stripped, runs about east and west and has a dip of 60 degrees to the south. The ore is mostly dark grey and very silicious, and contains some pyrites so as to be of little value. Part of the silicious matter has the white sandy look seen in similar circumstances at the Helen mine and part has a cherty character. The appearance of this belt is therefore entirely different from that of the nearly parallel jasper belt five or six miles to the south and so far as known there is no connection between the two. From this point it may be followed a little north of east, up the valley of a creek, one of the tributaries of Carp river ; and Mr. W. P. Gray, who has done some blasting and development work, states that the band may be traced for five and a half or six miles, and has everywhere about the same character.

Apparently the Mammoth deposit is of the same kind as described by Mr. Holmes, though we were unable to find the belt, which does not show on the trail. Whether the Mammoth is connected with the Vulcan or runs parallel to it could not be determined, but the survey of the two locations shows them running parallel to one another with an interval of about a quarter of a mile between. The outcrops which we examined extended for about half a mile with some interruptions, and in dimensions and character correspond to Mr. Holmes' description, but not to the quotations which he makes from Hugh Wilson's report on the property, made years ago. The latter states that "the ore was traced over an area which was estimated on the ground to measure 50 by 30 chains, and therefore equal to 150 acres ; making every allowance it would certainly occupy half that extent[7]". The ore which was to be seen resembled very much that on Mr. Miller's property north-east of the "Soo" and also that from Clear lake, north of Sudbury, but the associated rocks are not Laurentian, being more like Huronian. The lofty hill which rises behind the first stripping consists mainly of diabase, so far as seen, and this is much the commonest rock in the region, in varieties running from medium textured to compact basaltic looking rock. The only other rock observed near the iron belt is flesh-colored quartz porphyry often sheared into felsite schist, but whether this or the diabase is the older was not certainly determined.

A mile or two north of the locations many boulders of granite occur along the trail, and probably the boundary between the Laurentian and Huronian was passed, though the wooded character of the region and the lack of rock exposures made the question hard to decide. Mr. J. A. Holmes mentions gneiss also as associated with diabase at one of the outcrops of ore, but we did not see the spot he refers to.

[7] Bur. Mines, 1900, p. 162.

Of the two bands of iron ore north of Batchawana bay, the jasper band to which the railway was graded seems the more promising, since its character corresponds more closely with that of the Marquette and Vermilion iron ranges ; but at present neither shows evidence of large bodies of good ore.

Michipicoton Harbor and Helen Mine.

Although the region about Michipicoton Harbor and the Helen mine has been referred to before in reports of the Bureau of Mines,[8] the recent development of the railway and mine made another examination desirable.

The clearing of the town site at Michipicoton Harbour has disclosed some fine outcrops of schist conglomerate, one in the town having a strike of 60 degrees and a dip of 50 or 60 degrees to the southeast ; while another a quarter of a mile up the railway on the left strikes 55 degrees and dips 60 degrees to the southeast. The pebbles and occasional large boulders enclosed in the rock are mostly porphyry, though granite, green schist and rather large pebbles of black chert occur also, so that this is no doubt a continuation of the Doré river conglomerate mentioned in a former report.[9] The conglomerate may be followed at least three miles up the railway, though in places there are few pebbles in the green chloritic matrix of schist, and it is last seen near a trestle across a creek at that distance from the Harbor. Sand plains belonging to one of the old beaches so common in the region then hide the rock, but in one place near the west end of the plain a boss of diabase much seamed with thin sheets of calcite rises through the drift.

At Wawa station rather dark green chlorite schist occurs, somewhat like the matrix of the conglomerate, but no enclosed pebbles were found. Then come sheared felsite and quartz porphyry, pale greenish and brownish, in part turned to sericite schist ; while just west of Sayer lake a sandstone breccia shows itself, a singular rock consisting of angular fragments of white, sugary looking sandstone of very fine grain with a fine grained gray or brownish matrix.

A rock cut on the railway at the west end of Sayer lake, the lower of the two ponds near the Helen mine, displays fine grained sandstone, banded black and white, striking about 30 degrees and dipping 80 degrees to the southeast ; while a hundred yards east of this the strike has changed to about 80 degrees, nearly east and west ; and 200 yards farther east it is 20 degrees with a dip of 70 degrees to the east, indicating a rapid curvature in these rocks.

Boyer lake has been lowered five feet since last summer by cutting away the rock barrier between it and Sayer lake, thus disclosing tolerably fresh rock at the outlet, a pale brownish carbonate of iron containing much pyrite and some sandy particles, and weathering to a brown mass of impure iron oxide.

The same banded sandstone seen in cuttings on Sayer lake continues on the north side of Boyer lake, at the northeast end of which the strike is about northeast and southwest ; and some parts of it are brecciated with a rusty looking cement. On the south side of the lake the railway cutting shows light green schist mottled with darker chlorite schist, on the east, but changing to an auto breccia of pale schistose rock toward the west.

DEVELOPMENTS AT THE HELEN MINE.

Since last year the little valley has been greatly changed by the cutting of a railway track, largely out of solid rock, round the pond called Boyer lake ; and by the work of developing the mine, which has been carried on by open cuts, drifts and diamond drill borings. The ore deposit is now better outlined than before and proves to be of very large dimensions. As stated by Captain Williams it is 1090 feet in greatest length (from northeast to southwest) and has a width over all of 400 feet ; and it reaches, as shown by borings, 188 feet below lake level and rises as a hill 100 feet above water, a thickness of 288 feet in all. A drift run into the hill toward

[8] Bur. Mines, 1899, pp. 254-258 ; also 1900, pp. 154-164. [9] Ibid, 1899, pp. 164-166.

the east passes first through loose materials, sand with boulders, some of them banded sandstone, others of the impure siderite of the hill rising 450 feet to the east, the boulders being changed in various degrees into ore, some of them completely so.

About 40 feet in the drift there is a band of white or gray sand, soft and very fine, 10 feet wide, sometimes passing into the banded sandstone mentioned before, but good ore occurs beyond this almost to the end of the tunnel, 260 feet, when pyritous chloritic schist was encountered and the drift was stopped. The ore from the drift is partly soft and partly hard, and most of it is of good quality.

The character of the ore is much better shown now than before the development, and it has been proved to consist largely of red hematite, both soft and hard, in addition to the brown ore. The latter is sometimes beautifully stalactitic and concretionary, and occasionally has brilliant blue and green colors, due in all probability to thin films of oxide. The yellow variety of limonite occurs also, though not in large amount, and it is said that analyses of the fibrous, stalactitic ore prove it to be goethite rather than limonite. In general the only impurities in the ore visible to the eye are portions of the sandstone mentioned before, though at times small crystals of clear quartz occur also ; and the only source of sulphur observed seems to be the pyrites of the unchanged carbonate which occurs as boulders in part of the ore. There is less of the "blue" ore, or hard steel gray hematite, to be found at the Helen mine than in most of the Marquette or Vermilion range iron mines ; and the considerable amount of limonite present suggests a likeness to the Mesabi ores of Minnesota. The fact too that no jasper, but only sandy looking materials, occur near the ore body, points somewhat in the same direction.

The ore from the Helen mine contains too much phosphorus to be of bessemer grade, and so does not equal the best of the ores from Michigan or Minnesota, bnt it stands high among the non-bessemer ores. Analyses of the core obtained in boring 188 feet below Boyer lake average as follows :

SiO^2	2.28
Fe	63.83
P	.09
S	.03

Some assays gave as high as 69 per cent. of iron, and the lowest amount of phosphorus found was .02 per cent.[10]

SIDERITE THE SOURCE OF THE ORE.

The source of the iron has been made clear by the later explorations, since diamond drill cores obtained from various depths consist of siderite, as shown by Mr. Clergue's chemists. One from a point between 129 and 142 feet down yielded 36.54 per cent. of iron, equivalent to 75.69 per cent. of carbonate of iron, and is therefore an impure siderite. Another specimen contained only 60.39 per cent. of carbonate of iron and 29.61 per cent. of insoluble matter, mainly silica ; and a third said to consist of orthoclase with siderite gave only 9.55 of carbonate of iron.

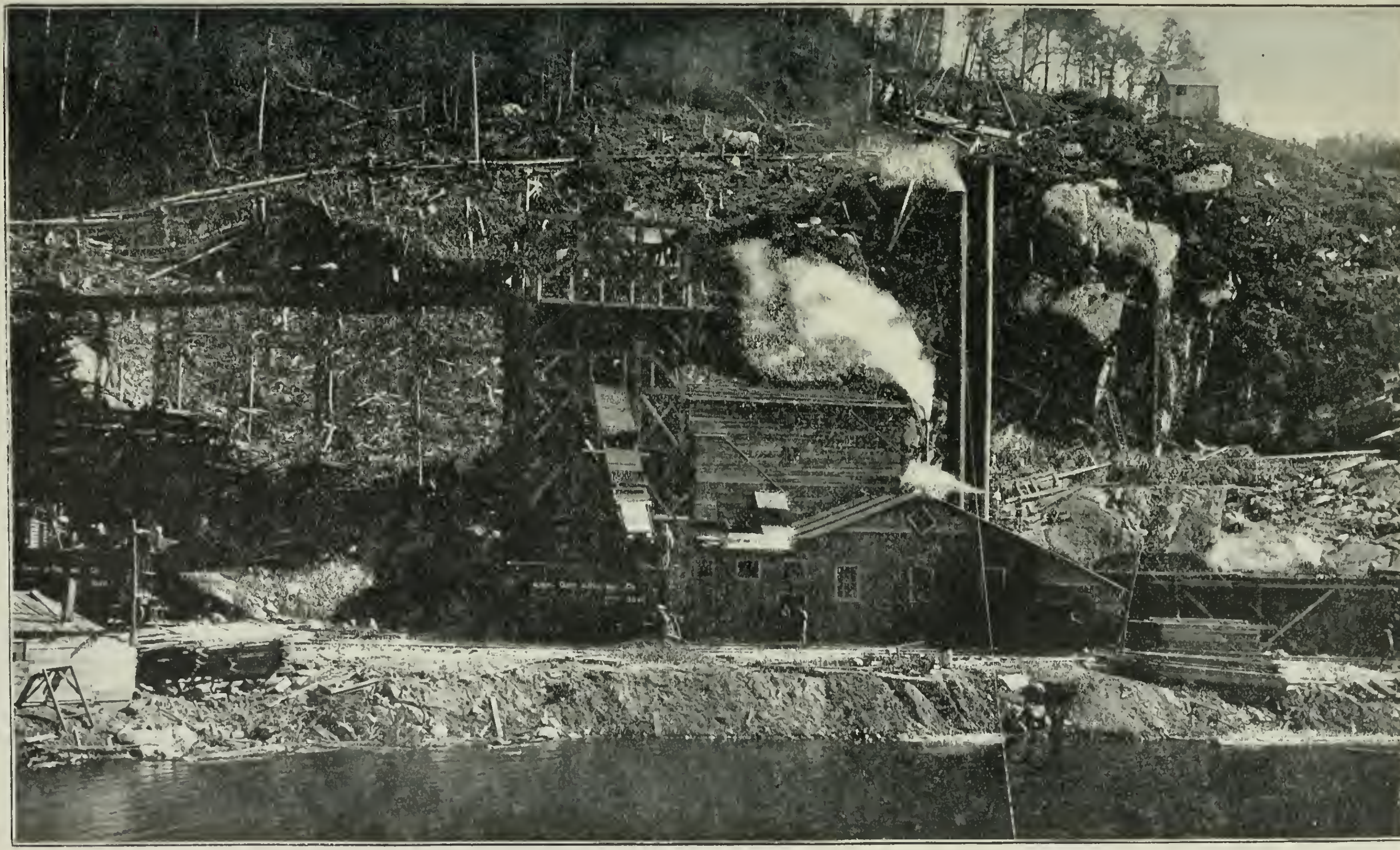
The singular rusty rock at the outlet of Boyer lake, brownish gray and compact and containing much pyrite when unweathered turns out to be siderite also ; and the same is true of the

[10] An average analysis of Helen ore made from samples taken from 20,000 tons in the stock pile at the Canada Iron Furnace Company's smelter, Midland, in September, 1900, is as follows:

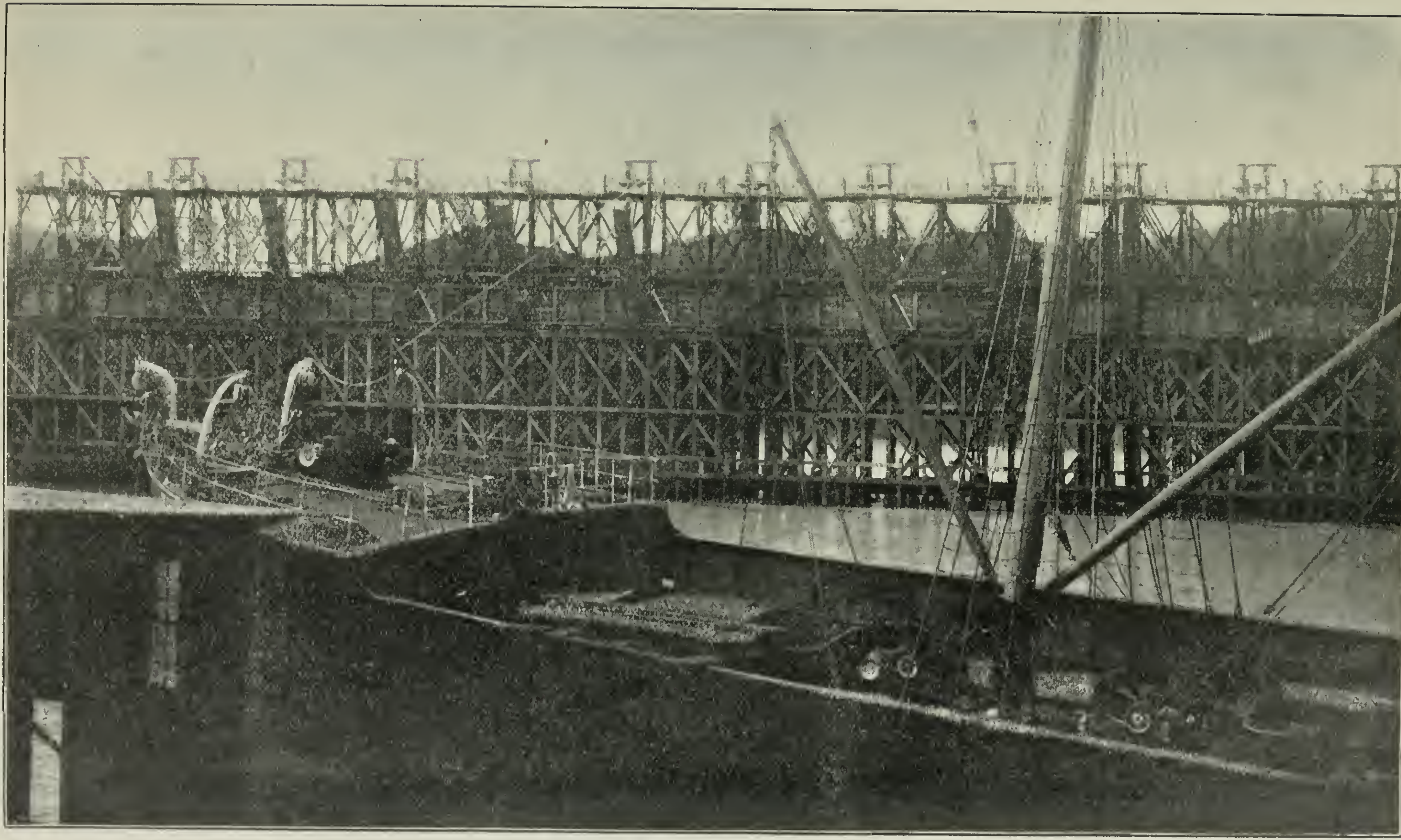
Moisture at 212°F	6.610	per cent.
Iron	58.700	"
Silica	5.660	"
Alumina	0.730	"
Lime (CaO)	0.210	"
Magnesia (MgO)	trace.	
Phosphorus	0.114	"
Sulphur	0.047	"
Organic matter and combined water	9.670	"
Insoluble	6.040	"

[25] Helen Iron Mine: General View, August 1900.

[26] Helen Iron Mine, Second Bench; August 1900.



[27] Helen Iron Mine: Plant for Crushing Ore.



[28] Temporary Ore Dock of Lake Superior Power Company, Michipicoton Harbor.

rock forming much of the hill which rises 450 feet above the same lake toward the east. This in fresh samples below the brown crust of limonite produced by weathering, is bluish gray, compact, and contains a good deal of pyrite ; and on analysis turns out to be an impure siderite.

A specimen, taken to illustrate the weathering, from one of Mr. Ely's claims on top of the hill shows very interestingly how the process goes on. The rock is attacked along fissures almost invisible in the unweathered rock, and a sharp edge of whiter material separates the unchanged from the oxidized rock. The thin whiter layer is granular and consists largely of tiny particles of quartz, apparently rejected when the limonite was formed. Analyses of specimens from the hill top and from the outlet of Boyer lake have been made by myself, No. 1 being from the hill and No. 2 from the west end of the lake, and the results are as follows :

	No. 1.	No. 2.
Insoluble	4.38	14.76
Carbonate of iron	78.57	74.07
Carbonate of magnesia	12.84	8.75
Carbonate of lime	4.09	0.79
Alumina	trace	trace
Total	99.88	98.37
Specific gravity	3.681	3.587
Metallic iron	37.71	35.70

The insoluble residue consists mainly of very fine particles of silica, and in the analysis no other elements were looked for than those given ; but as sample No. 2 was slightly weathered there may have been a small amount of moisture which would account for the low result on summing up. No account was taken of the iron pyrites, which would have given a considerable amount of sulphur, perhaps even one or two per cent., but would have made no other change than to lower the amount of carbonate to an equivalent extent. But for the pyrites the rock from the hill would be accounted a fair ore of iron in some parts of Europe ; and if this siderite were roasted it would yield a product having 56.57 per cent. of iron, not more than 7 per cent. below the iron contents of the ore from the mine ; and if the sulphur were all roasted out would form a very fair ore, having 9.17 per cent of magnesia, and 3.42 of lime to serve as fluxes for 6.56 per cent. of insoluble material, mainly silica.

The source of the ore is then readily accounted for. Evidently in the process of dissolving and re-depositing the iron in the basin of Boyer lake most of the sulphur, lime and magnesia have been removed ; and the silica has probably been left behind, as for example, in the fine sandy belt ten feet wide found in the drift.

In order to get a clear idea of the character of this rock which furnishes the ore of the Helen mine a sample from a drill core obtained at a depth between 376 and 389 feet below the surface, starting 45 feet south of the road to the camp, was analysed by Mr. A. H. Robinson of the staff of the School of Practical Science, Toronto, with the following results :

SiO^2	20.87	H^2O at 100° C	.04
Al^2O^3	3.29	CO^2	28.75
Fe^2O^3	2.50	FeS^2	1.53
FeO	33.90		
MnO	.45		99.82
CaO	3.25	Specific gravity	3.37
MgO	5.24		

The rock taken for analysis is pale brownish with some streaks of a bluish and also whitish color, the latter no doubt including most of the silica, and the bluish part most of the alumina and some iron oxide in the form of a silicate. The results of this complete analysis are very like those of the two partial analyses given before except for the larger percentage of silica. The results of a microscopic examination of this rock will be given later.

HOW THE ORE WAS DEPOSITED.

In last year's report the rock taken for felsite in our hurried field work is this iron carbonate ;[11] and as it was found to be 78 feet wide and to extend for a long distance along the ridge, we may imagine its destruction by weathering in the western part of the range to have furnished all the ore now found at the mine. Just why the weathering should have taken place where the hollow of Boyer lake has been formed is not very clear ; but that portion of the range may have been shattered by the earth movements suggested by the breccias of sandstone and felsite found near the lake. We must suppose the two little lakes, Boyer and Sayer, to have been formed by solution ; since no other force, such as glacial action, seems capable of carving these basins, each a quarter of a mile long and 1·5 feet deep, just to the west of a hill rising 4·0 feet and between steep walls of a schist one or two hundred feet high on each side. They are undoubted rock basins, for the solid rim of rock to the west of each is unmistakable. Why was no ore deposited in Sayer lake ? The only difference between its basin and that of Boyer lake is the presence of the high hill with its band of siderite to the east of the latter lake, furnishing the raw material for the ore.

At the time of our visit to the mine a diamond drill was at work at a pond to the east of Boyer lake, on the side of Hematite mountain, the intention being to bore diagonally into the hill so as to determine whether there is an ore body included in it.

THE MINE AND ITS SURROUNDINGS.

On 6 July matters were just getting into shape for work on a large scale, Messrs. Powel and Mitchell having contracted to mine, crush and load the ore on cars. A large crusher was about complete and a cableway was being arranged to take the ore to it. At that time it was intended to have 500 or 600 men at work during the fall and to be in a condition to handle from 3,000 to 5,000 tons per day next summer. While we were there three carloads mainly of soft red hematite, were loaded with shovels and sent down to the harbor for shipment on one of the steamers lying there, and this was stated to be the first ore sent out.

The ore pocket on the dock was still unfinished, but seems to have been completed and put in use some time later, since 62,000 tons of ore are said to have been shipped to Midland and other points before the close of navigation, almost as large a quantity as had been mined in the whole of Canada in the previous year.

As the tiny, steep-walled valley occupied by Boyer lake and the hill of ore left little enough space for the necessary railway and buildings for crushing and handling the ore, the houses for the camp had been put up 150 feet above the lake on the hill to the south, where a somewhat uneven and rocky surface had been cleared on which to plant a village.

The town at the Harbor, where there had been only unbroken forest at our visit the previous summer, was already a bustling place with numerous buildings and a considerable population. Much of it stands on a terrace of sand and stratified clay near the shore of lake Superior ; and the same blue clay is said to underlie part of the harbor, giving excellent ground into which to drive piles for the ore docks, etc. The clay rises in one of the railway cuttings about 100 feet above the lake, and goes 160 feet below it, as proved in driving piles ; so that it

11 Bur. Mines, 1900, p. 156.

is present in unexpected amounts. All the terraces inland, as near the Post and Wawa, are of sand, as mentioned in previous reports.

Mr. E. V. Clergue, to whom I am much indebted for information and great assistance in various other ways, states that the explorations carried out by the company since the previous year have shown that the iron range is interrupted for two miles, between Hematite hill and Eleanor lake ; but then goes on to Red lake near Park's lake, where the Josephine mine is being developed. This mine appears to be of much promise, and important deposits of ore are reported also from a new range found by Professor Willmott north of Paint lake and west of Iron lake near Dog river. Under Professor Willmott a series of explorations has been started to determine the economic value of the region, and to make a geological map of the country to be served by the Algoma Central railway and its branches. In such good hands we may expect important economic results as well as a most useful map of this hitherto little known district.

Comparison with American Iron Ranges.

The development of the mine during the past year makes it possible to compare its geological relationships with those of the American iron ranges across lake Superior more satisfactorily than could be done previously, and the results are of some importance as suggesting the probable conditions under which ore should be looked for at other points in Ontario. Excellent accounts of some of the American ranges have been given by geologists of the United States Survey ; Irving and Van Hise discussing the Penokee range of Michigan and Wisconsin in 1892 ; [12] and Van Hise, Bayley and Smyth the Marquette district of Michigan in 1897.[13] Other districts of Michigan are described more briefly by Clements, Smyth, etc. in 1899 ; [14] and a large amount of work has been done on the Minnesota iron regions by the Survey of that state ; the results being given in their reports, the most important by N. H. Winchell on the Iron Ores of Minnesota in 1891 ; and Spurr's report on the Mesabi Range in 1894.

THE ROCKS OF THE HELEN MINE.

The iron-bearing rocks at the Helen mine have a width over all from north to south of 800 to 1,000 feet as shown east of Boyer lake, which corresponds fairly with that given for the Marquette and other ranges of about 800 feet, though this width is sometimes exceeded in the American iron regions. The rocks stand nearly vertical, so that the width makes also the thickness ; and in general the iron-bearing band runs parallel to the schistose rocks on each side, though it has sometimes been shattered and brecciated, and near Sayer lake has been bent into a nearly vertical fold. Up to the present there is little to show which side of the range is the base, i.e., in what order the strata were laid down ; since, unfortunately, the schist conglomerate representing the basal bed of the Upper Huronian, shown at the Harbor and for some miles along the railway, has not been traced all the way to the ore deposit, so that its relation to the latter is unknown. If the two were found in contact the conglomerate would of course be uppermost, and the succession would probably though not necessarily be such that the bed beneath it would be the highest in the Lower Huronian. The only point suggesting a solution of the problem is the fact that most of the sandy rock interbanded with iron ore is on the north side and most of the siderite on the south side. As it has been found in the Penokee range that the purer iron carbonate occupies usually the upper horizons and the cherty rock the lower ones,[15] there is some probability that the southern side was originally uppermost.

The succession from north to south as far as can be judged at the mine begins with a series of ridges of green schist at least an eighth of a mile broad, followed by four or five hundred feet of granular silica interbanded with iron ore and probably about four hundred feet of siderite

12 U.S. Geol. Sur. Monograph XIX. 13 Ibid. Monograph XXVII.

14 Ibid. 19th Am. Rep., Part III. 15 U.S. Geol. Sur. Monograph XIX., p. 292, etc.

beneath the ore deposit. South of this comes a ridge of felsite schist turned into "paint" rock and "soap" rock next the ore, with various green schists, probably sheared eruptives, beyond.

The section across the top of Hematite mountain, as worked out last year is somewhat different, but the wooded hill top gave only a poor exposure, and the costean pit examined did not run the whole way across. The section begins with the same sandstone and chert banded with iron ore of undetermined width, followed by 75 feet of a partly schistose greatly weathered brown rock, an impure siderite with silica and also sericite or talc ; then 24 feet of siderite with some bands of green schist, followed by 54 feet of nearly pure siderite showing no cleavage or bedding, in all 103 feet of more or less pure siderite. Next comes a thin band of granular silica succeeded by a few feet of greenish and yellowish brown schist and 150 feet of soft green schist, the two latter rocks probably representing the felsitic and chloritic schists of the section at the east end of Boyer lake.

The different members of the band vary in thickness from point to point, and the length of the siderite as seen by us is not more than a mile and a quarter in a direction about east and west, from the east end of Hematite mountain, which is about three quarters of a mile long, to a little beyond the west end of Sayer lake. It should be mentioned that the width of the sandstone and siderite at the west of Sayer lake was estimated at 1000 feet, but it was interrupted near the middle by 200 feet of green schist with some slate. The south shore of this lake is partly formed by a large mass of pyrite mixed with sandy grains, apparently a greatly modified variety of the granular silica.

Two miles to the east of Hematite mountain and south of lake Eleanor the siderite is found again, but is apparently absent for the two miles between. Here also it is exposed on a steep hill along with iron-bearing silica, the siderite showing as a narrow band on the face of a cliff. It is of interest to note that black carbonaceous shale is exposed to the south of this hill, as in some of the American iron ranges.

Professor Willmott has found that the cherty siderite continues to a point three miles east of Goetz lake, a distance in all of about 8 miles. Adjoining it east of Goetz lake there is a cherty limestone which probably corresponds to the limestone or dolomite found below the iron-bearing member in Michigan and Wisconsin.

PENOKEE AND MICHIPICOTON SIDERITES.

In the first detailed description of the iron ranges of the states just mentioned Irving and Van Hise refer the iron-bearing rocks to three main types "(1) Slaty and often cherty iron carbonate, (2) ferruginous slates and ferruginous cherts, and (3) actinolitic and magnetitic slates ;" [16] and the first type is said to be well marked and present in considerable thickness, having iron carbonate as its chief constituent, but usually mingled with more or less cherty silica and calcium and magnesium carbonates. This corresponds well with the rock found on Hematite hill and in borings from beneath the Helen ore deposit ; but in one respect the Penokee siderite seems to differ from that of the Helen mine, since it is described as generally platy and thinly stratified, while much of that from Boyer lake and Hematite mountain looks very massive. Analyses of these rocks [17] show on the whole much more silica than the analyses given earlier in this report, running from 15.62 to 58.23 per cent., while the lime and magnesia range about the same.

The ferruginous slates and cherts are described as consisting of minutely crystalline or chalcedonic silica with magnetite, hematite or brown iron ore in varying quantities, and sometimes also a little actinolite (gruenerite in later reports) and remnants of siderite. The silica is sometimes granular but non-fragmental and is generally like chert. Perfectly white varieties free from iron occur but there are gray and rarely black examples also, as well as red ones

16 U. S. Geol. Sur., Mon. XIX, Penokee Series, p. 190. 17 Ibid., p. 192.

running into jasper. They may be laminated or irregularly banded with silica and iron ore.

The sandstone-like rock at the Helen mine corresponds exactly to the coarser textured variety described above, consisting of angular grains of silica showing no sign of rounding by water or of secondary enlargement, and evidently formed by a chemical process. The iron ore interbanded with it varies in character, but no variety containing red hematite or approaching jasper has been found near Michipicoton, though jaspery varieties occur a few miles to the north. In general then the granular silica rock of the Helen mine is the equivalent of the second type described by Irving and Van Hise.

The third type, the actinolitic (grueneritic) and magnetitic slates, has not yet been found on the Michipicoton range but seems of importance farther west, on the shores of Greenwater lake west of Port Arthur.

ASSOCIATED ROCKS UNLIKE THOSE OF AMERICAN RANGES

The accompanying rocks of the Penokee iron range in Michigan and Wisconsin differ widely from those of the Michipicoton range ; since the Penokee range rests on quartzite or quartz slate, which overlies cherty limestone, the latter resting on the Archæan complex ; and is covered by the upper slates, fragmental rocks resting conformably on the iron-bearing series. At the Helen mine no equivalent for these lower and upper sedimentary rocks has been found, the enclosing rocks being felsitic and chloritic schists, apparently sheared cruptives. It should be added however that in the Penokee range also there are numerous eruptives, partly sheets interleaved with the iron-bearing rocks and partly cutting them as dikes.

In the Marquette region the underlying rocks are slate or quartzite as before, but there is a non-conformity between the iron-bearing rocks and the Goodrich quartzite which rests upon it, though the difference in dip is not generally great. [18]

The character of the iron-bearing rocks of the Marquette range is on the whole the same as in the Penokee range, though jaspery varieties are more common ; a point of difference from the Michipicoton range, where jaspers are lacking altogether at the Helen mine and at Gros Cap, and are uncommon in other parts of the range, as well as dull and poorly colored where they do occur.

In the Vermilion range of Minnesota the differences are still greater, since carbonate of iron appears to be absent and the ore is almost always associated with jasper, more rarely with chert and apparently never with the white, granular sandstone-like rock. On the other hand the enclosing rocks are largely schists and greenstones not greatly different from the green schists north and south of the Helen mine, distinctly sedimentary rocks being less important. [19]

The Mesabi iron range belonging to the Animikie (or Taconic) as defined by the Minnesota Geological Survey may be supposed to come higher up in the geological scale than the Michipicoton range, but yet may be compared with it in some respects. Here the original rock of the iron-bearing series is of a different nature from any that have hitherto been mentioned, being according to Spurr a greenish granular glauconitic rock, generally changed into what is named taconite, a gray, red or green rock consisting largely of crpytocrystalline silica and iron oxides, but of variable character. [20] Spurr thinks that the other rocks found in the lake Superior iron ranges began as glauconite sediments, but those of the Mesabi range being of later age have retained their original character better than the others. The underlying rock of this range is quartzite and the overlying rock a great thickness of black slate sometimes at the base an impure limestone often dolomitized or sideritized ; while the taconite itself has a thickness of about

[18] U. S. Geol. Sur., Mon. XXVIII, p. 334. [19] The Iron Ores of Minnesota, N. H. Winchell, 1891, p. 24, etc.

[20] The Mesabi Iron-bearing Rocks, 1894, p. 248, etc.

800 feet. There is however one very striking difference from all the other ranges in the fact that the Mesabi rocks are almost horizontal instead of standing nearly vertical. The general character of the Mesabi ore, the beds of white sandy silica sometimes associated with it and the fact that the ore bodies are usually covered only with drift and unconsolidated materials are points of resemblance to features of the Helen mine; which differs in these respects from the other iron ranges referred to.

FORMATION OF THE ORE BODY.

In one characteristic feature the Michipicoton ore body differs from almost all of the others in that it is not formed in a plunging syncline nor in a trough between a dike and some impervious stratum underlying the iron-bearing member. Instead, the cavity in which the cake-shaped ore body lies seems to be hollowed out of the iron-bearing rocks themselves, especially the impure carbonate. The side walls of the basin are apparently sheared eruptives, but the bottom and ends seem to be mainly of the siderite though perhaps partly of the sandy iron-bearing rock. The porous character of much of the ore and the small amounts of sandy silica enclosed in it show that in part at least the iron has replaced other materials which were loose in texture like the sandy rock or had been shattered so as to allow water to circulate. Probably however most of the ore has been formed by the weathering, solution and re-deposition of materials from the siderite, for the ore contains smaller amounts of impurities than would arise from the change of the siderite directly into oxide. The concretionary and stalactitic form of much of the limonite or goethite of the ore proves that at least part of the brown ore was deposited from solution in cavities between the shattered pieces of the original rock.

As the region of the Helen mine is the best explored of our iron ranges more space has been devoted to its geology than would be justified for the others, and not much need be said of them. The only other example of the occurrence of siderite observed in our work is north of Shining Tree lake, where small amounts of a dark gray, very impure carbonate of iron are found just beside jasper banded with iron ore. As the outcrop is small and rises out of a broad swamp it cannot be told whether larger quantities of the siderite are concealed in the lower ground; but to the northwest, where the surface rises into hills, only gray cherty material was found, though siderite may be hidden under the mossy ground on either side. The succession of rocks at this point beginning from below is diabase, chert about 300 feet wide, diabase again and ash rocks merging apparently into conglomerate containing fragments of jasper, evidently the basal bed of the Upper Huronian.

GENESIS OF THE IRON-BEARING ROCKS.

These rather mysterious belts of iron-bearing rock are far below the ordinary fossiliferous sediments, unless the Mesabi range, the highest of them, is equivalent to part of the Cambrian; and many speculations have been indulged in regarding their origin. The jasper-magnetite bands have even been regarded as eruptives of a peculiar kind greatly modified by subsequent changes caused by circulating waters, the idea being suggested by the banding, which resembles that of some volcanic rocks; but this theory has little support and is no longer held even by its originator, Dr. E. M. Wadsworth.

A more elaborate theory proposed by the Winchells in the reports of the Minnesota Survey, after weighing a number of other hypotheses, suggests that the original source of the iron is to be found in the decay of basic eruptive rocks poured or flung out into the ocean. As it was a time of eruptive activity, probably often submarine, the sea was heated up and rendered alkaline and so became important as a chemical force. The basic eruptive minerals were rapidly attacked by this means and decomposed, providing solutions of iron and of silica, which

are supposed to have been precipitated during the cooling of the waters as layers of silica and of iron ore, providing the banded jaspers. The ore was afterwards concentrated in the present ore bodies by solution and re-deposition.[21] This theory is not an unnatural one as founded on the geology of the Vermilion range of Minnesota, where jasper or chert is interbanded with hematite or magnetite, the whole having a structure parallel to that of the other rocks in which the iron range is enclosed.

Irving and Van Hise, working in the Penokee region, where the cherty siderite appeared to be the rock from which the other varieties such as the banded cherts and the hornblende magnetite schists were formed, concluded that this was the original material of the iron-bearing rocks. They suppose it to have been deposited from solution in sea water, perhaps by purely physical or chemical means, or more probably by the aid of organisms. In the latter case the iron is thought to have been deposited as bog ore is now, in the form of hydrous sesquioxide, which was afterwards changed into carbonate by the presence of organic matter. Some of the Penokee carbonates still contain a large percentage of organic matter, and some of the black slates associated with similar ores in other regions are quite like the carbonaceous slates of the Carboniferous rocks. That carbonate ores of a very similar kind have been deposited in later times is proved by numerous examples. The cherty or chalcedonic silica found in most of the siderites they think to be of organic origin also, just as cherty and flinty materials in later carbonates, for example many limestones, were formed of the spicules of sponges, etc. On this theory the sea must have been at a normal temperature and not so very different from the present, since plants and animals could exist in it.[22]

Spurr carries the origin of the iron-bearing rock a stage further back, considering the cherty carbonate itself to be a secondary rock formed from a sediment, for some obviously detrital grains occur in the siderite. This primitive sediment is best preserved in one of the iron-bearing rocks of the Mesabi, which is thought by Prof. Wolff and himself to be a glauconite deposit like the glauconite sands and muds of later seas. In this theory also organisms play a part, since glauconite is generally deposited in or about the shells of foraminifers.[23]

Smyth discusses the same question briefly in his account of the Groveland iron district of Michigan, showing that there are sometimes detrital grains of quartz in the iron-bearing rock and also oval and rounded forms suggesting glauconite. He thinks that either or both of the two last mentioned theories may be correct, but inclines to the theory of glauconite as the origin of the ores.[24]

Professor N. H. Winchell returns to the question of the origin of the iron-bearing rocks in the final report of the Minnesota Survey and concludes that the green sand of Wolff and Spurr was not organic, but in reality formed from a volcanic sand.[25]

As far as the Canadian localities are concerned, the most primitive form of the iron-bearing rock appears to be the impure cherty siderite, and there is no direct evidence to carry one back of this, since the peculiar oölitic forms of the rocks relied on as suggesting either life or a concretionary structure in basic lava have not yet been found in the ranges referred to here as Lower Huronian. They have been found, it is true, in the Animikie, both in jaspers and in cherts, from the Port Arthur region, but thus far not associated with iron ores of importance. Winchell's latest theory presents some serious difficulties in application, two of which may be mentioned here. Basic lavas contain only a small percentage of iron as a rule and not a high percentage of silica, while half their weight generally consists of such ingredients as alumina, magnesia, etc., not very easily removed by solution. How comes it that in most

21 Iron Ores of Minnesota, p. 103, etc.

22 U. S. Geol. Sur., Mon. XIX, p. 245, etc.

23 Mesabi Iron-bearing Rocks, p. 227, etc.

24 Crystal Falls Iron-bearing Dist. of Mich., U. S. Geol. Sur., An. Rep. 1897-98, part III, pp. 117-121.

25 Geol. and Nat. Hist. Sur. Min., vol. 5, pp. 990 and 991.

parts of the range only silica and iron remain? Again, is it imaginable that basic volcanic sands of the proper kind should be rained down so as to produce just a maximum of 800 or 1,000 feet of iron-bearing rock everywhere from Minnesota to the Province of Quebec or even to Labrador? The vast extent over which the iron-bearing rocks have been traced is a point which cannot be overlooked in a theory accounting for their origin.

Whatever the cause or causes of these rocks, they seem to have been produced twice in the early history of America with a great interval between; for rocks of the kind are found not only in the Lower Huronian, now almost everywhere on edge and greatly folded and brecciated, but also after these beds had been metamorphosed from their original materials into jasper or sandy rock, raised into mountain forms, eroded to an enormous depth and once more immersed in the sea, for in every part of the wide region mentioned the Upper Huronian begins with a basal conglomerate containing jasper or the sandy rock. Whether the flat-lying Animikie with its jaspery ores belongs to the Upper Huronian or forms a third iron-bearing horizon need not be discussed here.

Extent of the Iron Ranges of Ontario.

The work of the past summer has greatly extended our knowledge of the iron ranges of Ontario and makes it possible to give a general outline of the distribution of the Lower Huronian iron-bearing rocks. It has long been known that the Vermilion iron range of Minnesota crossed the boundary into Ontario at Hunter's island, and jaspery iron ores have been found at various points in that region, e.g. by W. H. C. Smith on Jasper lake, where banded jasper and hematite have a width of 40 or 50 feet[26] Brecciated jasper and iron ore are known from the Mattawin region also[27], and from a number of points to the north as noted by Dr. Bell; but in the latter case the deposits may be of Animikie age and therefore not to be included here[28].

Jasper pebbles are numerous at Lac Seul and in other places west and north-west of lake Nipigon, but their source has not been found and it is possible that they may have come long distances during the Ice age, perhaps from some of the deposits near Hudson bay, reported by Dr. Bell.

In the band of Huronian mapped as running eastward from lake Nipigon in the direction of Long lake, a deposit of banded jasper and iron ore has been examined by Mr. J. Watson Bain, near the mouth of Black Sturgeon river, and an extension of it is reported from the same stretch of Huronian, north of Long lake. To the south of this ten or twelve miles from the mouth of Pic river the other type of deposit is found, brecciated granular silica with magnetite.

The Michipicoton range is separated from this by a wide area of Laurentian, and the first outcrop occurs about fifteen miles west of Iron lake, near the head waters of Dog river. It is jaspery and cherty with interbanded magnetite and hématite; but on the eastward extension of the line across Dog river one finds the granular variety mixed with magnetite near Paint lake. A few miles to the north what appears to be a parallel band has been traced by Professor Willmott and has been found to include promising ore deposits. The whole extent of this range as traced by Professor Willmott is about 27 miles, the longest continuous stretch in Ontario.

Farther to the east not much has been reported until Magpie river is crossed by Speight's east and west base line, where a range of hills with jaspery and cherty material interbanded with ore runs two or three miles southeasterly. Six or eight miles to the south the iron bearing rocks are found again near Parks lake and can be followed four or five miles west and south-

[26] Geol. Sur. Can., 1890-91, 63 G. [27] Bur. Mines, 1895, p. 83; and Geol. Sur. Can., 1897, p. 57 H.

[28] Ibid. 1866-9, p. 330; and 1886, pp. 14 and 15.

west, including the promising Josephine mine now being developed. In the same direction is lake Eleanor where siderite and the banded silica are found ; and two miles west is the Boyer lake property described before, the band having a length of about a mile and a quarter and running east and west. Ten miles to the southwest is the Gros Cap deposit of sandy and quartzitic rock interbanded with hematite, sunk upon many years ago but not developed to any great extent as a mine. Rock of the same sort has been found near Michipicoton Post and Cape Choyé, Professor Willmott having ascertained the latter range to be six miles long, though without ore so far as known.

ORES OF THE EASTERN HURONIAN BELT.

Once more a wide band of Laurentian intervenes, the next examples of the iron formation occurring 65 miles to the south, near Batchawana bay, where two bands run nearly parallel to one another, about east and west, each from four and a half to five miles long, with reported finds some miles to the east on Harmony river and to the west near Pointe aux Mines on lake Superior. The two bands differ in character, the one to the south being of jasper with hematite and that to the north cherty or quartzitic with magnetite.

The next known locality, about nine miles northeast of the Sault, is of the same character as the last and is enclosed in Laurentian rocks instead of Huronian or basic eruptives as in most other localities. The wide band of Huronian between the "Soo" and Sudbury is not known to contain any rocks of the iron formation, though the large numbers of bright red jasper pebbles in the conglomerates of the Upper Huronian must have a source somewhere in the region.

In the considerable area of Huronian north of Woman river, on the main line of the Canadian Pacific railway, jaspery iron ore has been reported but no details have been obtained regarding it. To the east of this Mr. Whitson has examined a jasper range running several miles in a southeasterly direction between the upper end of Onaping lake and Meteor lake ; and about twenty-five miles to the northeast is a range of jasper, chert and impure siderite with magnetite and limonite of the Shining Tree lake region, running somewhat west of north and south of east for three and a half miles and perhaps for double that distance. A few miles farther northeast jasper is reported from one of the chain of lakes belonging to Montreal river, and still farther to the north at Night Hawk lake.

In the southern portion of this Huronian region rocks of the kind occur on the northwest shore of lake Wahnapitae as dull red jasper and chert with magnetite, and extend west into the Laurentian in Hutton and Wisner townships. It may be that there are two separate bands here, the southern one east and west and the northern one north and south, the latter the more important as containing what are said to be large deposits of magnetite.

Of the iron range to the northeast of lake Wahnapitae Professor Miller reports that "starting from lake Temiscaming on the east the first outcrop, which is of small size and and was not visited by me, is situated a short distance east of the east end of Rabbit lake. The next outcrops occur along the northeast shore of the east end of the northeast arm of lake Temagami, the band here stretching from near Snake lake west to Tetapaga. Outcrops occur also near the end of Matagama point. A belt lies parallel to these outcrops to the northward and runs, with breaks here and there, from near the west side of Net lake to Kokoko lake.

"Then there is an isolated belt stretching from near Cross lake north of west past the southern extremity of the south arm of Temagami to the southwest arm of the same sheet of water, and to the westward outcrops are found on Emerald lake. A band, more or less broken, runs

along the north of lake Wahnapitae northwest into and through part of the township of Hutton."

He adds that "in nearly all cases the iron ore, magnetite, is intimately interbanded with jasper, which varies much in color in different parts of the field. In some outcrops the magnetite is pretty massive and if situated near a railroad could apparently be worked profitably. The breadth of the band of interlaminated material is sometimes 600 feet or more. It is at times much bent and fractured, having been disturbed by igneous intrusions, and some of these disturbed bands give evidence of being worthy of more careful prospecting than we were able to do in the limited time at our disposal."

Belts of iron-bearing rocks like those described in this report are found also in Quebec though up to the present little has been done in searching them out. Mr. McOuat has reported from the eighth portage of the Quinze, on the head-waters of the Ottawa above lake Temiscaming, an ore which forms "layers from the thickness of paper to about an inch, and is interlaminated with similar layers of whitish-grey and dull red fine-grained quartzite. The iron ore constitutes probably from a fourth to a third of the whole, and as the thickness of the whole band is about thirty feet, the total thickness of the layers of iron ore would probably not be less than eight feet."[29] This is evidently the same type of deposit as those described from Ontario.

Mr. A. P. Low describes jaspery iron ores which he compares with those of Michigan and also cherty iron carbonates from various points in Labrador, and probably some of these occurrences are Lower Huronian, though from his description it is clear that most of them are of Animikie age.[30]

From the statement just given it will be seen that bands of jaspery, cherty, or sandstone-like rock interbanded with magnetite, hematite or limonite and sometimes associated with siderite occur from point to point across the whole of northern Ontario, with lengths varying from a hundred feet to 27 miles. Almost all of the important areas mapped as Huronian have more or less extensive belts of this rock, and in several cases isolated patches or strips of it occur in the Laurentian, as if these were remnants left when less resistant Huronian rocks had disappeared. These portions contained in the granite are never red jasper, but generally cherty or quartzitic, and the iron ore is magnetite, whereas in Huronian areas we generally find jasper or granular silica with hematite or limonite.

LAURENTIAN OR LOWER HURONIAN?

It has been taken for granted in this report that all of these iron bearing rocks are of the same age, near the upper part of the Lower Huronian: but there is a possibility that rocks of different ages are included among them, i.e. that the same conditions recurred more than once and were followed by similar results.

Excluding the iron-bearing jaspers, cherts and siderites of the Animikie, generally easily distinguishable by the fact that they lie nearly flat and are associated with rocks much less metamorphosed, often even modern looking; the probability seems strong that the steeply tilted lower Huronian iron-bearing rocks are all of the same age.

It is true that Bayley finds jasper banded with iron ore and other forms of the iron-bearing series in Kitchi schists of the Marquette region which he places in the basement complex, looked on by the U. S. Geological Survey as equivalent to the Laurentian; but he considers them vein formations.[31] As neither jasper nor chert have ever been found in rocks classed as Laurentian in Canada there is no reason to hesitate in our case as to the Huronian position of the

[29] Geo. Sur. Can., 1872-73, p. 131. [30] Ibid. 1895, Part L. p. 283, etc. [31] Monograph XXVIII, pp. 186-188.

iron-bearing jaspers and cherts. Is it not possible that a mistake has been made in regard to the Michigan Archæan jaspery rocks? They are described as resembling closely the corresponding rocks of the Negaunee iron-bearing formation, and they were present in large amounts before the basal conglomerate of the lowest portion of the Huronian,[32] for this is said to contain pebbles of jasper and chert in various places, often in considerable numbers. It would accord better with Canadian usage to consider the Kitchi schists with their jaspery bands as Lower Huronian sediments nipped into the Laurentian and so avoid the assumption of numerous veins containing jasper in a series of rocks on the whole poor in iron. However it may be in Michigan, there is no direct evidence of Laurentian jaspery iron ores in Ontario, and we may consider all the belts of that material mentioned above as belonging to the same horizon and formed under similar conditions.

A point which supports this is the finding in many cases of basal conglomerates of the overlying rocks within a mile or two of the iron-bearing bands, containing pebbles of jasper, chert or sandstone evidently obtained from them. There might be a coincidence in the formation of similar ferruginous rocks at different horizons in the same region, but one can hardly believe that there would also be a repetition of the basal conglomerates.

BASAL CONGLOMERATES OF UPPER HURONIAN.

As the jasper or sandstone-like pebbles in basal conglomerates of the Upper Huronian have generally been derived from adjacent parts of the iron range their distribution is of interest and has been worked out wherever possible. A sketch of the distribution as far as known was given a year ago in a discussion of the Upper and Lower Huronian of Ontario;[33] but the additional information obtained may be set down here.

The Doré river conglomerate which contains many pebbles of sandstone and chert has been found to extend within a few miles of the Helen mine and to be about 24 miles in length from the mouth of Dog river on the west where it begins. In sections of some of the pebbles siderite has been found proving that materials exactly like those at the mine were rolled on the inter-Huronian beach before the conglomerate was formed. Similar conglomerates have been found at other points in this Huronian area, for instance two or three miles north of Goetz lake, not far from the Josephine mine.

Conglomerates have not yet been found nearer the Batchawana jasper and chert beds than at the north end of Goulais bay fifteen miles to the south, where Murray mapped jasper conglomerate many years ago. The extensive bands of quartzitic conglomerate containing blood-red jasper pebbles in the original Huronian region, extending from lake George almost to Thessalon, about 30 miles, and found in several different bands, some of them quite to the north of those mapped by Murray, have never been accounted for, since no jasper has been found nearer than Batchawana more than 50 miles to the northwest, and there the jaspers are much duller in color. The accompanying black chert pebbles which are equally common might have been supplied by the cherty iron ore band nine miles northeast of the Sault Ste. Marie, mentioned in a previous part of this report, though this is about ten miles from the nearest of the conglomerates. The region is, however, little known beyond the few miles of settled country along the St. Mary's river and the north shore of lake Huron, and future exploration may solve the problem.

Numerous conglomerates occur along the same stretch of Huronian to Sudbury, but no jasper or chert pebbles are known in them, though they are found in quartzites and graywackés somewhat farther east on lake Matagamashing,[34] not far from the jasper-iron ore belt north of lake Wahnapitae. Small amounts of jasper conglomerate have been noted northward from

32 Ibid., p. 303, etc. 33 Bur. Mines, 1900, pp. 182-186. 34 Dr. Bell in Geol. Sur. Can., 1890-91, p. 15 F.

this, and a graywacké conglomerate containing jasper and chert pebbles extends for some miles parallel to the Shining Tree lake iron range but a mile or two to the west.

East of lake Wahnapitae conglomerates with jasper are known at various points to lake Temiscaming and also on the Quebec shore of that lake near Baie des Péres. That they extend still farther to the east is shown by Low's report on Labrador where conglomerates with Laurentian boulders and jasper boulders and pebbles seem to be common.[35]

It is not certain of course that every one of these rocks containing pebbles of jasper, chert or sandstone is a basal conglomerate of the Upper Huronian, but many of them undoubtedly are; and in the majority of cases the source of their pebbles is found in adjoining bands of silicious iron-bearing rocks which may be looked on as belonging to a horizon near the top of the Lower Huronian, Van Hise's Mareniscan.

The past summer's work adds largely to the known extent of the basal conglomerate of the Upper Huronian containing pebbles of the iron-bearing series, and increases the probability that the two groups of rocks represent definite horizons in the Huronian which may be used in correlating the rocks of this age in the different and often widely separated regions where they have been found.

It is a question whether Canadian geologists are justified in including two series of rocks separated by so widespread a non-conformity in the same formation. If we divide them up no doubt the part here called Upper Huronian corresponds most exactly with Logan and Murray's original Huronian, and should retain the name. Though a portion of Dr. Lawson's Keewatin is certainly to be classed with the upper division or typical Huronian, most of it appears to belong to the lower part, which may appropriately retain the name of Keewatin. Perhaps however the term Ontarian, suggested by Lawson to include the Keewatin and Couchiching, may be thought more suitable, though the same name has since been given to a much later group of rocks in the United States, which might give rise to confusion.

PETROGRAPHICAL AND STRATIGRAPHICAL NOTES.

The most important series of rocks examined are those belonging to the iron ranges of various parts of Ontario, and these will therefore be taken up first, beginning with the carbonates as most fundamental, and then going on to the silicious varieties and their accompanying rocks.

The Siderite Series

The impure siderites in the neighborhood of the Helen mine are of considerable variety, running from perfectly fresh compact rocks of pale purplish gray with a conchoidal fracture to brownish rusty looking schists. Some contain only a little iron pyrites, others are heavily charged with it. In the purest and freshest example, from the top of Hematite mountain, the siderite is finely granular and so like a fine grained dolomite or marble as to be taken for it at first. The small amount of silica is present as clear grains of quartz, no amorphous or cryptocrystalline silica being seen, and except quartz there is no mineral but pyrite in tiny grains and crystals. In more silicious varieties similar quartz grains interlocking with one another and showing no hints of a clastic character, form vague bands across the slide and vary from very fine particles to rather coarse textured aggregates; in the latter case the grains are frequently

[35] Geol. Sur. Can., 1895, 256 and 274 L.

broken and the parts somewhat shifted. The least pure specimen, from a diamond drill core, contains a yellowish brown mineral in rounded grains, and also a considerable amount of hornblende. The nature of the brown mineral is not certain, though its color and dichroism suggest titanite, but no titanium has been found on analysis. The brown grains have an indistinct cleavage with a varying angle of extinction as measured from it; and are often surrounded with a rim of a mineral looking like the adjoining carbonate of iron but apparently a little more highly refractive. The hornblende has blue-green, blue and yellowish-green pleochroism and a low angle of extinction, and generally forms prisms with an almost opaque central part bordered by clear and transparent edges. It seems to approach glaucophane rather than gruenerite in its characters. The hornblende sometimes makes slightly radiating bundles and is associated with the brown mineral previously mentioned and many particles of magnetite. In this section one large and somewhat rounded quartz grain, broken but without shifting of the parts, suggests a clastic origin.

The only section made of a schistose siderite has the silica sheared into a very finely granular condition not unlike the non-radiate variety of chalcedony. There is some magnetite present and the edges of the rhombs of siderite are brownish, while some have been wholly changed into pseudomorphous limonite. Many scales of what look like sericite but are more probably talc are mixed with the cryptocrystalline silica and by their parallelism cause the schistose cleavage.

A section of bluish gray carbonate from north of Shining Tree lake consists of about equal parts of chalcedonic silica and siderite, the latter somewhat decomposed and opaque. The rock has been cracked in places and re-cemented by very thin sheets of chalcedony, showing that at least part of the silica has been deposited since the rock became solid.

Silicious Rocks and Quartzites.

The sandstone-like rock interbedded with iron ore consists always of polygonal grains of clear quartz of variable size, generally associated with either magnetite grains, diffused brown iron ore or siderite, the latter occasionally completely changed to pseudomorphs of the brown ore. None of the sections have the appearance of a clastic rock under the microscope, since the quartz grains interlock perfectly; but in some of them they are not coherent and films of iron oxide lie between them. The pulverulent character of many of these rocks is explained by the fact that the quartz polyhedrons are not at all cemented, a point distinguishing them from quartzites.

The iron-bearing rock from the Wilson or Vulcan mine near Batchawana varies from the dark red of jasper to the iron gray of cherty iron ore. The silica is mainly chalcedonic, and the iron ore includes hematite, magnetite and a very little siderite. In one slide there are also a few tiny prisms of pale hornblende.

A specimen of magnetic banded quartzite from the band south of Clear lake in the Sudbury region, proves under the microscope to have no chalcedonic silica but only large and small interlocking areas of quartz with many square crystals of magnetite and a very little much decayed hornblende. The larger quartz areas have some extraordinary features, since one sees many long parallel lines of minute inclusions, often of liquid with a bubble as shown by high powers, oriented parallel or at right angles to the chief axis, for extinction is always in the same direction. In several of these areas there is a well marked parting at right angles to the lines of inclusions, suggesting either a basal or prismatic cleavage, probably the former.

Rocks of the Sudbury Region.

As Sudbury was our headquarters for the earlier part of our work any spare time between excursions was used in studying the geology of the neighborhood, which has never been worked out in detail, though the region as a whole has been mapped by Dr. Bell,[36] and some of its rocks have been studied microscopically by the late Prof. G. H. Williams[37] and Prof. Bonney.[38] The nickel mining region has now been opened up sufficiently by roads and clearings as well as by the development of the mines to make a more thorough study of its petrography and stratigraphy desirable. The following notes may serve as a contribution towards that end.

In connection with this it may be mentioned that the belt of eruptive greenstone associated with nickel and copper ores mapped by Dr. Bell as striking northeast across the northeastern corner of Morgan township has since been proved mainly by the work of prospectors, to extend eastwards past the north end of Joe's or Marion lake in Wisner township into Norman township, joining the area of diabase west of lake Wahnapitae.[39] The band, which has all been taken up as nickel locations, varies in width from a quarter of a mile to a mile or more and includes some green schists and other rocks of a Huronian aspect though passing most of the way through Laurentian looking rocks. Including the areas to the east and west already represented on the map this belt is about 23 miles long running round the northeast end of the supposed Cambrian area. Several promising nickel properties have been found on it, though not much work has yet been done upon them.

Among the basic eruptives north of Sudbury the coarsest grained, as far as observed, is a dark gray gabbro rising as small ridges northwest of the Nickel Mountain mine, looking very like diorite. Under the microscope it is found to consist mainly of greenish gray rhombic augite and plagioclase. As the augite shows only traces of pleochroism and contains no inclusions such as are common in hypersthene, it may be named enstatite. It is often idiomorphic, and is associated with diallage, resembling it much in appearance but less in amount. The other ferro-magnesian silicates are pale brown faintly dichroic hornblende, and deep brown biotite, both without idiomorphic form and in sparing amounts. The plagioclase, which has wide twin lamellae and extinction angles indicating labradorite, in general occupies the spaces between the enstatite individuals. It is usually a good deal crushed, as if the rock had been squeezed and the felspar had yielded more easily than the augites. A small amount of magnetite is the only accessory mineral to be seen.

On the rock dump of the Nickel Mountain mine two varieties of basic rock are found, one gray and medium in grain, the other greenish black and very fine-grained, with some pyrrhotite in it. The coarser-grained rock has the structure of a gabbro verging towards diabase. the felspars being somewhat elongated but often fairly well formed, while the dark minerals also tend towards idiomorphy. A small amount of clear quartz was the last mineral to form, occupying irregular, sometimes triangular, spaces between the others ; while on the whole the plagioclase, which ranges from rather basic oligoclase to labradorite, was the first to crystallize. The augite has almost all weathered to greenish hornblende, and this is mixed with dark brown biotite often enclosing large masses of magnetite and almost certainly secondary. The plagioclase sometimes has undulatory extinction but in general the rock shows few signs of strain.

The finer grained rock, which is slightly schistose and looks almost like a dark quartzite, is a gabbro also but with little or no quartz. The felspar is in tiny square forms sometimes showing no twin lines, often two halves, but more frequently several twin lamellae, occasionally of two kinds meeting nearly at a right angle. From the extinction angles the felspar must be a

[36] Geol. Sur. Can., 1890-91, part F. [37] Ibid p. 57 F, etc. [38] Quart. Jour. Geol. Soc., London, vol. 44, pp. 32-44.
[39] Can. Rec. Science, April, 1893, p. 346.

very basic labradorite ; and probably the untwinned crystals, which resemble the others closely, are of the same nature. The dark minerals are augite and hypersthene in nearly equal amount, with green secondary hornblende along certain bands, probably where shearing has taken place. There are many square sections of magnetite. On the whole this rock is very like a gabbro found 20 miles to the north near Clear lake[40] in the northern nickel range.

Between the Nickel Mountain mine and the Stobie mine the rocks observed are chiefly diabases and green schists, the latter sometimes porphyritic, either hornblende or what appear to be plagioclase crystals being embedded in a fine grained dark green groundmass.

One of the latter was sectioned and proves to be a very quartzose hornblende porphyroid. What were taken for felspar crystals turn out to consist of finely granular quartz in clear and often perfectly interlocking areas, but with a good deal of epidote between the quartz grains in some parts. Around the clear quartz there is a thin band of dark green hornblende particles, and then quartz again as a narrow strip. The rest of the rock consists of green hornblende, epidote, magnetite and a little quartz, the latter often enclosed as small grains in large hornblende crystals, suggesting the poikilitic structure. though the quartz granules have no definite orientation. The rock probably represents a greatly metamorphosed diorite porphyrite.

Through the green stones there are numerous irregular eruptive looking masses of flesh-red rock like microgranite, specked with small black hornblende crystals. Under the microscope one finds quartz, orthoclase, microcline, microperthite, oligoclase and magnetite, with a patch or two of tangled fibres of hornblende, the whole of a uniform granular character except for some larger masses of microcline with irregular edges. The appearance suggests somewhat a very fresh and fine grained arkose, though in the field the rock was considered to be eruptive. Some of the grains looked sedimentary, but there are no visible secondary enlargements and the grains in general seem to interlock, so that the rock is probably to be called a microgranite.[41]

The rock dump at the Stobie mine shows materials resembling those of the Nickel Mountain mine though on the whole finer grained. The very fine-grained gabbro looking something like dark felsite occurs here too ; but at least part of the rock is diabase, the ophitic structure of lath-shaped felspars being well displayed, though the section examined is very badly weathered

Huronian Sedimentary Rocks.

The opening of new railways near Sudbury gives an opportunity to study the sedimentary rocks of the region more completely than before, and some of them will be described, commencing with those found along the spur line leading to the Ford mine west of the branch from Sudbury to the Stobie mine.

A small patch of white quartzite is found where the road turns west, and is followed by a slaty rock with layers of conglomerate in places, the pebbles of white quartz and other darker rocks being well rounded. The most interesting phase of the rock, to the north of the railway, contains many crescent-shaped pieces of white quartz, sometimes four inches from one horn to the other of the crescent. Occasionally beneath a crescent is a round portion of quartz suggesting an eye and eyebrow ; and a very few examples show more than one crescent arranged concentrically. By what means these crescent-shaped strips of quartz were split off from the original pebble is by no means clear. The rock enclosing the pebbles is a very fine-grained quartzite containing many shreds of brownish green hornblende, and a few decayed fragments of felspar. Though no secondary enlargements can be seen and the grains generally interlock, the appearance is that of a greatly modified sediment.

As one approaches Sudbury from the mines to the north a gray slaty or quartzitic looking rock is met with showing very distinct bedding, quartzitic and slaty layers alternating. There

40 Can. Rec. Science, April, 1893, p. 344.

41 Cf. Prof. Williams, Ibid., p. 61F.

is no true slaty cleavage. On weathered surfaces the slaty parts are attacked more rapidly than the quartzitic parts which stand out prominently and sometimes show curious relationships between the two rocks, rounded or wave-like projections of the sandy layers projecting into the other part and even forming separate rounded masses. The parallel and very uniform lamination of the beds above and below show that this structure is not due to shearing but is probably an original relationship of the sediments. There are also rounded concretionary masses in the slaty rock, some as much as 9 inches long ; and square looking prisms sometimes half an inch long exposed on weathered surfaces, the latter perhaps definite minerals in the beginning though now consisting of granular quartz.

Thin sections show that the slaty parts consist of a very fine-grained mass of quartz grains with dull green chlorite, some sericite and a little magnetite. The quartzitic parts have well rounded grains of quartz, badly weathered grains of felspar and scales of chlorite.[42] The prismatic parts consist essentially of quartz in interlocking grains without any common direction of polarization. What mineral they follow as a pseudomorph is not certain, though the forms suggest andalusite.

The rocks just described have a well marked bedding with a strike of 47 to 60 degrees east of north and a nearly vertical dip. Some parts however have been much broken and faulted, sometimes showing small step faults but occasionally sheared faults accompanied by crush breccias or conglomerates, perhaps formed when the large boss of diabase to the northeast of the town was erupted.

About two miles to the east of Sudbury along the railway dark gray graywacké conglomerate is found enclosing pebbles and boulders of various kinds but none of the iron-bearing series so far as observed. The cement consists of angular fragments of granitic looking quartz with some decaying felspars, and many shreds of hornblende and chlorite. The strike of the rock at the point visited and on the shore of Ramsay lake could not be definitely settled.

The new Manitoulin and North Shore railway, which runs west from the town gives some excellent exposures, mainly of quartzite which often has the appearance of fine grained gneiss, and is sometimes massive looking, with little to show the direction of the bedding. At a point about one and a quarter miles west of Sudbury the strike was found to be north 75 degrees east, and the dip about 80 degrees to the south. The quartzite is partly dark gray with thin interbedded slaty layers, probably a continuation of the rocks described from the northwest part of the town, and partly pink and very fine-grained so as to be felsitic looking, or slightly coarser grained like micro-gneiss. Portions of the latter are faintly stratified, the layers often greatly contorted or sheared into a kind of conglomerate.

The latter rock under the microscope is found to be very like a fine grained gneiss though the quartz is present in rather too large an amount and its grains sometimes show roundings. It is an arkose largely rearranged as a gneiss, and but for its association with well defined sedimentary rocks might be taken for a gneiss. The felsitic looking variety, which has a faint banding of greenish and reddish tones is finer-grained under the microscope and more distinctly clastic ; and the darker variety may be described as graywacké, consisting of quartz fragments of various sizes with hornblende and chlorite. The pale flesh-colored variety extends to the northwest of the slaty variety and the greywacké as a long range of light-colored hills that can be followed by the eye for several miles.

A hill top rising through the woods south of Sudbury consists of slaty silicious rock having a strike varying from 15 degrees west to 38 degrees east of north, but very irregular and contorted, some of it forming a coarse crush conglomerate.

42 Prof. Williams, Geol. Sur. Can., 1890-91, Part F., p. 71.

Rocks Found by Exploring Parties.

A large number of rock specimens were collected by the various exploring parties sent out into northern and northwestern Ontario last summer and many of them were brought to the School of Practical Science for determination. The majority were ordinary gneisses and granites of the Laurentian, weathered diabases or green schists probably of the Lower Huronian, or quartzites and arkoses of the Upper Huronian ; and to describe them in detail would be simply a repetition of matter already touched on more or less fully in previous reports.

It was intended to compare the materials brought back with a view to work out the general petrography of the region, but the materials on hand are so unequally distributed and so hard to place geographically in advance of the map which is to accompany the reports that this design has been given up.

The massive rocks include granite, syenite, quartz porphyry, quartzless porphyry, felsite, diorite, gabbro and diabase ; the schistose forms of most of these rocks have been found also, including various gneisses, diorite schist, hornblende schist, hornblende-epidote schist, chlorite schist, sericite schist, talc schist and others. The sedimentary rocks include various quartzites, arkoses conglomerates, phyllites and slates, and a few limestones and dolomites, some of the latter belonging to the Silurian and Devonian rocks of the Hudson Bay slope and containing well preserved brachiopods and corals. With these exceptions and also a few drift boulders and pebbles, all the rocks obtained have the look of the Archæan, *i.e.*, Laurentian or Huronian.

A few of the numerous thin sections prepared will be described since they present points of interest.

The most interesting granite is a pale whitish or flesh-colored pegmatite brought back by Mr. G. M. Stewart from near Mattawishguaia river. It consists chiefly of microcline intergrown with oligoclase forming perthite, and also in part with quartz, making pegmatite. The only other mineral is muscovite. The microcline has all phases from the usual clothlike texture to large areas entirely untwinned, and the edges between the twin lamellæ vary similarly, some being vague and others as clean cut and sharp as in ordinary plagioclases. The slide is so cut that the angles of extinction on each side of the twin planes are nearly equal, 16 degrees and 19 degrees and at their maximum. The plagioclase wanders rather irregularly across the microcline with which it is parallel in orientation, and has an extinction angle of 3 or 4 degrees from the plane of twinning, indicating oligoclase rather than albite which is commonly assumed to exist in microperthite.

A coarse-grained grayish green eruptive brought by Mr. A. H. A. Robinson from the outlet of Ogoké lake proves to lie between diallagite and hornblendite since it consists of about equal parts of diallage and hornblende with a little pale green biotite, titanite and serpentine. The diallage often has a fairly good crystal form and was the first mineral to crystallize. Much of the hornblende seems primary, and this mineral sometimes appears as large porphyritic individuals. Felspar is almost altogether absent, so that the rock is a very basic one.

A handsome porphyrite brought by the same explorer from the west side of Pigeon lake deserves mention. Megascopically it consists of a fine-grained dark green ground with pale green rhombic sections of felspar sometimes an inch in length. It should make a handsome ornamental stone Under the microscope the ground mass is found to consist of ophitically arranged plagioclase strips with augite and magnetite, i.e. to be a diabase. In this there are scattered many fairly large crystals of plagioclase and polysomatic masses of augite, and a few very large felspars greatly weathered into a fibrous material resembling muscovite. The felspar in fresh portions shows no twin striations which suggests orthoclase, though the association of porphyritic orthoclases with so basic a rock as diabase porphyrite seems improbable. The large felspar areas are polysomatic and are in part enclosed with a narrow reaction rim of paler augite and plagioclase than that of the general ground.

Some of Mr. J. E. Davison's rocks from the neighborhood of Sturgeon lake may be mentioned. A small area of green somewhat schistose rock from White Rock lake ten miles north of Sturgeon lake proves to be amygdaloidal in appearance. The body of the rock is weathered into a chloritic mass with a little quartz but the seeming amygdules, which are small, are sharply defined and well rounded, containing quartz, epidote and calcite or dolomite. Some are completely filled with quartz, others with epidote and still others with a mixture of minerals. The rock is of special interest as suggesting surface lava flows, which are unusual in our Huronian.

An impure cherty dolomite from the same general region gives a hint of the Lower Huronian such as one finds associated with the iron range in various places, though no iron-bearing rock was found by the party.

A rather pure crystalline dolomite found by Mr. E. V. Neelands on Pine lake on the Kenogami river was interbedded between layers of gneiss of Laurentian look and suggests the Grenville series of southeastern Ontario. Under the microscope a very little plagioclase and a trace of chlorite are seen, but the greater part of the rock consists of rather coarsely crystalline dolomite.

NOTES ON PLEISTOCENE GEOLOGY.

Most of our work in the earlier part of the summer lay in the wide-spread sands and gravels of the Hudson Bay watershed north and northwest of Sudbury where the evidences of the action of ice and also of large bodies of water are clear, so that much of the report on the Meteor lake-Vermilion placer region may be looked on as a contribution to Pleistocene geology. It will therefore not be necessary to recapitulate the results of those observations, and this portion of the report will omit details, giving only the more important facts elicited.

The gravels and sands are usually well stratified where exposed on the banks of rivers and lakes and have not the tumultuous look of kame deposits at the edge of an ice sheet. One may imagine them kame materials furnished by ice but worked over in a large body of water at the ice front. They stand at levels ranging from 1,420 near Meteor lake to about 1,000 at the southeast end of the region taken up as placers, and many of the sand and gravel beds form terraces, while other parts run as narrow ridges or eskers either across the gravel plains or towards their northern or northeastern edge. In extent these beds stretch from the portage between Muskegogema lake and the head waters of Spanish river to the small lakes east of Meteor lake along the Hudson Bay watershed, and then southeasterly to lake Wahnapitae, a distance in all of about 70 miles, though with some interruptions. Similar wide beds of sand and gravel occur at several other points, e.g., to the east of the lower end of lake Matagami where the portage 2½ miles long towards Shining Tree lake crosses such a plain with a kame ridge, and also to the south of this lake where there is a portage over a similar plain containing two kettle-shaped lakes, one without an outlet.

The kettle-shaped lakes with steep banks of sand and gravel formed by the burial of large ice masses at the edge of the retreating ice sheet and their removal by thawing at a later time are very common and characteristic. Some of the smaller ones are without visible inlet or outlet, their drainage probably going on by seepage through the gravel beds; but the larger one such as Meteor lake, which is three miles long and half a mile broad, have outlet streams. The basin of Meteor lake itself which now drains into Wahnapitae river and Georgian bay was probably a part of the Hudson Bay waters before the Ice Age; for it is now dammed at least in part by an esker running round its northern end.

The number of kettle lakes certainly exceeds a dozen in the whole region, most of them in the Meteor lake-Vermilion placer region but some west of Wahnapitae, others on the portage from Spanish river to Muskegogema lake and still others between Napawquazi and Matagami lakes. These ponds and lakes stand at all levels from 926 feet above the sea at Hale and Booth's lumber camp to more than 1,400. As kettle holes often enclosing lakes in sand and gravel deposits occur at Peninsula and several other points north of lake Superior, it seems that great numbers of them must exist on or near the watershed, much of which has not yet been explored with glacial geology in view.

The terrace like deposits north of the Hudson Bay watershed as well as the wide expanse of stratified clay found by the exploring expeditions of last summer indicate probably one or more post-glacial lakes ice-dammed towards the northeast. Where they emptied and whether to the south across the watershed to the St. Lawrence waters or in some roundabout way northward towards Hudson Bay cannot yet be determined, but further exploration should solve these interesting problems. Possibly a lake may have emptied along the direction of the placer beds between Meteor lake and lake Wahnapitae, though there is little direct evidence of this.

Terraces were found at many points in the region explored, and the more important may be given.

NEAR SUDBURY.

	Feet above sea level.
Meteor lake, sand and gravel terrace	1,420
Geneva lake, gravel terrace	1,400
Gravel plains south of Muskegogema lake	1,316
Sand and gravel terraces on a long lake expansion of Spanish river	1,335
Gordon's claim, Vermilion river, gravel terrace	1,047

NEAR MICHIPICOTON

Four miles up the railway, terrace	976
" " terrace	908
Stratified clay near Michipicoton harbor	700

NORTH OF BATCHAWANA BAY.

Highest terrace, wide and with rounded stones	1,152
Second terrace	1,047
Third terrace	967

The old water levels found in the last two localities correspond fairly well with beaches determined in previous years north of Sault Ste. Marie, northwest of it, and near Batchawana,[43] and also near Wawa lake.

Glacial striae have been observed at a number of points and their directions are given in the following table :

Sudbury, on quartzite		N. 35° E.
Geneva lake	about	N. 25° E
Two miles east of Straight lake		N. 13° E.
Nishikowgenda		N.
Shining Tree lake		N. 7° E.
Small lake east of Shining Tree lake		N. 10° W.
Lot. 9, Con. V., Meredith tp. north of Desbarats		N. 30° E.

The directions are magnetic, but the variation of the compass is not great.

43 Bur. Mines, 1899, p. 155 ; also 1900, pp. 175-176.

Morainic deposits such as boulder clays or stony ridges were observed at a number of points, but as none of them were followed up or mapped, to detail the individual instances would not be of value. Until the region is opened up by roads and settlements the mapping of moraines will be difficult, if not impossible.

THE IRON BELT ON LAKE NIPIGON.

BY J. W. BAIN.

Under instructions from the Director of the Bureau of Mines, I left Toronto on September 9, 1900 to examine some deposits of iron ore which had recently been found on the east shore of lake Nipigon. Arriving at Nipigon station by rail, I proceeded in company with Mr. Walter Beatty M.P.P. to Poplar Lodge, a winter post of the Hudson's Bay Company on the east shore of lake Nipigon, about twenty miles north from the mouth of the Nipigon river. After spending some days in examining the deposit and in making an excursion for some distance inland, I returned to Toronto on September 26.

Topography of the Region.

The country in the vicinity of Poplar Lodge consists chiefly of large flat areas, generally swampy, lying in basins with rocky ridges as retaining walls. Rock and soil are covered alike with a thick carpet of moss which very effectually conceals the surface of the ground and adds to the list of obstacles which beset the prospector. An almost unbroken sheet of green meets the eye in every direction ; only here and there are to be found bare hills which have afforded no places of lodgment for the roots of trees. Birch and poplar form by far the largest portion of the forest growth ; spruce is present in moderate quantity but is all of limited size, varying from four to eight inches in diameter ; jack pine, tamarac and cedar make up the balance.

Immense deposits of glacial clay are found at some points, and were the land cleared and drained in some of the flats it would probably be found to take fair rank for agricultural purposes. At other points, as at Poplar Lodge, the glacial deposits are sandy. This post is situated at one end of a crescent-shaped bay of the lake with a broad stretch of sandy beach such as one naturally associates with the sea-shore. From the beach back to the first rocky ridges some two miles inland, there is a flat, tree-covered plain with sandy soil, low swells of ground alternating with stretches of muskeg.

Jasper and Hematite.

Leaving Poplar Lodge and paddling some distance up Sandy river which runs past the post, a trail is found leading for a mile and a half across the plain to an exposure of the iron-bearing belt of rocks upon locations X 826 and 827. Two chains south of the northeast corner post of X 826, the iron-bearing band is encountered as a bare rounded ridge affording an excellent section some two hundred feet in width across the strike of the rocks, which is north 85 degrees east. To the north is dark gray country rock, exposed for some distance from the contact,

and to the south black ferruginous schists are found at the edge of the iron belt ; but low ground and soil prevent any detailed examination of the contact.

The material enclosed by these country rocks is a mixture of jasper and silicious red hematite with a little magnetite, the whole resembling very much the similar mixture found in the Michigan iron ranges. The amount of jasper present varies greatly. At some points the proportion rises to fifty per cent. and the material has a beautiful banded structure with alternating ayers of jasper and hematite The jasper is of a good red color and stands out prominently against the black background, so that where a portion of the surface has been smoothly finished by the glacier, the effect is very artistic. In other places, the jasper is entirely wanting and the hematite has lustrous surfaces upon the cleavage planes ; this appeared to be the highest quality, and a sample was selected for analysis. It yielded :—

Metallic iron	38.06 per cent.
Silica	40.60 "
Sulphur	traces.
Phosphorus	traces.
Titanium	none.

From this it will be seen that although the ore is almost free from injurious ingredients, it is much too low in iron to be of commercial importance ; and, as might be expected, the two general samples show still more unfavorable results. The first of these was obtained in the following manner :—Commencing from the southern edge of the ore body small samples were taken every two links (15.8 inches) across the surface at right angles to the strike until the northern edge was reached at a distance of 1.24 chains or 82 feet : these fragments were broken up and sampled in the usual manner. An assay shewed 30.06 per cent. of metallic iron. The second general sample was taken in the same fashion but commencing at the southern edge as before and ceasing at a distance of 54 feet, where it was evident that the quality of the ore was deteriorating. This contained 37.19 per cent. metallic iron.

One hundred feet farther west of the point where these samples were selected, the outcrop was again sampled in the same way and the content of metallic iron was 37.79 per cent. Some three hundred feet to the east of the discovery post where the first two general samples had been taken, an exposure of the belt was to be seen in low ground. A general sample across twenty feet of the mixed jasper and hematite yielded 34.02 per cent. metallic iron.

To the north the country rock, which also occurs as horses in the ore body, is dark and numerous particles of quartz may be seen by the naked eye ; under the microscope it is found that in an indefinite groundmass of chlorite and sericite with many cubes of magnetite, are set rounded and angular fragments of quartz resembling thosewhich occur in a conglomerate or ash rock. However, Dr. Coleman, who has kindly looked over the slides, believes that the rock is a quartz porphyry much sheared and altered, which would account for the peculiar forms of the quartz. The country rock to the south appears to be a slate, but the microscope shows it to be a very ferruginous schist with chlorite, quartz and an occasional crystal of tourmaline. As has been said before, the width of this belt of rock could not be ascertained. Considerable time was spent in walking along the iron-bearing formation both east and west, but no further exposures of any size or importance were to be seen within a distance of two miles ; lack of time and provisions forbade a more extensive exploration.

The district was first surveyed geologically by Peter McKellar under the direction of Dr. Robert Bell, and the results were published in the Report of the Geological Survey of Canada for 1866-9. McKellar paddled along the shore from the south-eastern corner of lake Nipigon,

and first found Huronian rocks in a cove a mile north of Black Water river. These dioritic, mixed with chloritic slates as he called them, continued for two miles and a half, then an exposure of trap occupied the shore for a short distance, succeeded by the Huronian rocks once more, extending up to and far past Poplar Lodge. It is evident then that the iron-bearing belt occurs in Huronian rocks as would be supposed, my own observations confirming those of McKellar. Hematite is referred to briefly in the report as follows :—" It was likewise observed by Mr. McKellar in small veins in several places along the lake shore between Poplar Lodge (old site) and Sandy river." I was told while in the district that the Hudson's Bay Company had taken up mineral locations upon the iron belt many years ago, but that all rights had been allowed to lapse ; no means of verifying this statement has been afforded.

A Jaspery Band to the East.

Another exposure of the iron-bearing rocks occurs some distance inland and is reached by paddling up the Sturgeon river, and making a two and a quarter mile portage to a series of small lakes, in all a distance of perhaps twelve or fifteen miles from Poplar Lodge. Upon the southern shore of the fourth of these lakes, dark ferruginous schists are found with here and there a streak of jasper. There is no material which would yield anything like as much iron as the ore at the principal exposure near the lake, and the interest attaching to this outcrop is at present only of a geological nature in that the possibility of a continuous belt is indicated. There is yet no evidence to shew the continuity of the belt, or the reverse ; for although the inland exposure, speaking roughly, lies east of the chief outcrop described above, the lakes are unmapped and their relative positions cannot be placed on a sketch with any certainty ; while at the same time the strike is almost due east and west as at the Poplar Lodge exposure. There remains of course the possibility that there are parallel bands, but at present nothing definite can be said regarding this.

The significance of this band of jasper-bearing rocks will be discussed by Dr. Coleman in his general summary and it may be stated briefly in this report that another has been added to the list of outcrops of the jasper rock, recently discovered in Ontario.

No ore of any value has yet been found on lake Nipigon, and the ore bodies if present at all are concealed by the soil in the more eroded portions of the belt. Careful test-pitting and diamond-drilling in the low-lying country may be necessary before any large bodies of ore are discovered. The district is still in the hands of the prospector, and much careful work must be done before even an approximate idea of the economic geology can be obtained.

SEA BEACHES OF EASTERN ONTARIO.

BY A P COLEMAN.

Ontario is generally considered one of the inland province of the Dominion of Canada, though it has a sea coast of its own on James bay extending for more than 200 miles from the boundary of the Northeast Territory to the mouth of Albany river, including sea ports at Albany river and Moose river. Until the projected railways reach tide water on James bay however our coastline will remain inaccessible, and the student of sea beaches if he would study them in Ontario, must content himself with those lying between the Ottawa and St. Lawrence rivers, now hundreds of feet above sea level.

The marine beaches and other deposits of eastern Ontario have been more or less studied for many years, and brief accounts of them may be found in the Geology of Canada[1] and Sir William Dawson's Canadian Ice Age,[2] as well as numerous references to their occurrence in the region in later papers on the Canadian Pleistocene. Dr. Bell and other geologists have found marine shells at various points along the great rivers flowing into Hudson Bay, also proving that the sea once encroached much farther toward the south than at present [3]

In accordance with instructions from Mr. Archibald Blue, Director of the Bureau of Mines, up to the summer of 1900, and from his successor, Mr. T. W. Gibson, a study has been made of these marine deposits, the results of which are given here. As few or no marine fossils have been reported west of a line drawn through Arnprior, Perth and Brockville, the field work was mainly confined to the part of the Province east of this, though the region to the west of Brockville was visited to determine whether sea beaches could be traced into the Lake Ontario basin. No attempt was made to visit every known locality for sea shells, and the work must be looked on as a reconnaissance rather than a complete study of the Pleistocene of eastern Ontario.

LEDA CLAY AND SAXICAVA SAND.

Sir William Dawson who laid the foundation of our knowledge of these deposits, divides them into the Leda clay and the Saxicava sand, from the commonest shells which occur in them. The Leda clay rests upon the boulder clay and is looked upon as a comparatively deep water deposit, while the overlying Saxicava sand was formed in shallow water.

The neighborhood of Ottawa presents the best opportunities for studying both divisions of the marine beds, and the large collections of shells made by Dr. Ami and other members of the Geological Survey as well as by private citizens are of great interest. Thanks are due to Dr. Dawson, late Director of the Survey, Dr. Ami, Mr. W. J. Wilson and others, for kind assistance while visiting typical localities and examining the collections of the Survey.

The best known localities for Leda clay near Ottawa are Green's creek and along the shore of the Ottawa river a few miles below the city at Besserer's wharf. The clay is bluish gray and well stratified and rises from 20 to 40 feet above the Ottawa, here about 118 feet above the sea. It contains great numbers of calcareous concretions, round or two or three times as long as broad, which are set free from the clay by the erosion of the river and lie as pebbles along the shore. Similar clay higher up and farther inland seems to be without them, perhaps not containing lime enough to form them.

Many of the concretions when heated and broken are found to contain a fish, often wonderfully well preserved, the only common species being the capelin, still numerous in the lower St.

1 Geol. Can., 1863, pp. 915-928.

2 Pp. 203 etc.

3 Geol. Sur. Can., 1871-2, p. 112; also 1875-6, p. 340. The sea shells reach about 450 feet above sea level on a tributary of Albany R.

Lawrence. Other nodules have been formed about plant remains, and a respectable flora has been obtained from them, the material being determined mainly by Sir William Dawson, and Professor Penhallow of McGill. Insects, feathers, bones of birds and bones of seals are found also, but very rarely. Besides the small shell, *Leda arctica*, from which the clay gets its name, specimens of *Saxicava rugosa* and *Macoma fragilis* may be picked up along the shore, though not abundantly. Sometimes also these shells have served as the nucleus about which carbonate of lime has been deposited, and are now enclosed in the nodules. The clay at this point, though rising only about 40 feet above the river, is said to reach 100 or more feet below it, as shown by borings for wells, and is, therefore, at least 140 feet thick.

Brickyards in Ottawa also give excellent exposures of the Leda clay from which a great number of marine fossils have been got, including several species of shells and silicious spicules of a sponge, looking like a tuft of coarse bristles. From washings of the clay many tiny foraminifers have been secured, and altogether 28 kinds of plants and at least 33 animals are known to occur in these clays.

Under the guidance of Mr. Wilson a visit was paid to a point in Nepean township, about 6 miles up the Rideau from Ottawa, where the Saxicava sand is well displayed. The surface of the river is here about 240 feet above the sea. Steep-cut banks show a section having 70 feet of stratified Leda clay at the bottom, followed by 40 feet of Saxicava sand, the whole reaching 350 feet above sea level. The clay is much like that at Besserer's, but shows no concretions. The stratified sand is more or less cross-bedded and contains shells practically to the top, though much the richer layer is just above the clay, as is usually the case in this region. Though the shells are numerous they are of three kinds only, *Saxicava rugosa*, *Macoma fragilis* and *Mytilus edulis*. The last shell, though fragile, is very well preserved, the two valves often united and the purplish color still well marked. The other two shells have lost their epidermis and are bleached white, but still remain sound and strong. A few specimens of "sea acorns," *Balanus crenatus*, and probably also a larger form, turn up less often.

The surface of the country above the escarpment is somewhat rolling and duny looking, with no well-marked shore line. Probably the sand was laid down as shoals in shallow water and not as part of a beach deposit. This seems to be one of the highest points at which fossils have been found near Ottawa on the Ontario side, but Dr. Ells has collected shells 450 feet above the sea at McGregor's lake, two miles north of Perkin's mills, on the Quebec side.

Concretions with fish are reported at other points down the Ottawa, towards Montreal, and up as far as lake Coulonge, an expansion of the Ottawa, 60 miles northwest of the city, where they occur at an elevation of 370 feet. Dr. Ells, from whom the foregoing is quoted, states also that shell-bearing sands are found to the west of Arnprior as high as 470 feet along the summit of rocky ridges.[4]

While Ottawa has proved the most prolific source of marine fossils in Ontario, the Leda clay of Montreal, not far beyond our border has proved still richer in organic remains ; and old marine deposits lower down the St. Lawrence, such as at Riviere du Loup, Murray Bay and Metis, have yielded a large number of species also. Probably the water as far up as Ottawa was somewhat brackish and not suitable for some forms of life that lived abundantly nearer to the open sea.

ORGANIC REMAINS NEAR SMITH'S FALLS.

Shell beds occur in stratified sand and gravel at many points south and west of Ottawa, and some of the localities examined will be reported on here. The finding of bones of a whale near Smith's Falls in 1882 attracted much attention at the time. The bones, which were sent to Sir William Dawson and are now in the Peter Redpath museum at Montreal, consist of two

[4] Sands and clays of the Ottawa Basin, R. W. Ells, Bul. Geol. Soc. Am., Vol 9, pp. 215 and 216.

vertebræ and a rib, the largest vertebra 11 inches in diameter and 7 inches in length ; the other 10 by 4. It has been determined as *Megaptera longimana*, a species still common in the gulf of St. Lawerence and sometimes ranging some distance up the river. The bones are in good preservation, but white and brittle from the loss of organic matter. Associated with them were shells of *Macoma fragilis*, a species common in the Saxicava sand. The find was made in a C. P. R. gravel pit at Welch's, three miles north of Smith's Falls, and, according to the railway levels, at a height of 440 feet above the sea.[5] These are the only remains of a large whale reported from Ontario ; though bones of the dolphin (*Beluga catodon*) have been found in Saxicava sand near Cornwall.

At present the gravel pit at Welch's shows a face of 52 feet consisting of coarse sand and gravel with many larger stones, the latter generally subangular or only partially rounded. Since the gravel pit has not been in use for some years the stratification is not well seen, sand having run down from above. No shells were found, but this was to be expected, since they tend to crumble when long exposed to the weather. The sand and gravel have not the look of the Saxicava sand near Ottawa, but are much coarser and less perfectly stratified ; nor do they seem to have been formed on a beach. They run as a ridge having a general direction about 15 degrees east of north, not far from the same as the striæ shown on well polished Potsdam sandstone a few hundred yards to the west, where 12 degrees east of north was observed. The gravel ridge has somewhat the look of a moraine and includes a shallow kettle hole with no outlet, just to the east of the highest part. The deposit seems to be a kame rather than a beach, the many large subangular boulders suggesting ice action. The ridge is not long enough or distinct enough to be an esker.

The bones are said to have occurred 30 feet below the surface of the gravel, but apparently the carcass of the whale was enclosed in a beach deposit formed against the flank of the ridge in post-glacial times. As the level of the track at Welch's is 431 feet above sea, and the gravel rises at its highest part 52 feet higher as determined by hand levels the summit of the ridge is 483 feet above the sea, but the old beach probably 40 feet lower.

From Franklin station, north of Welch's to Smith's Falls on the south, no other stratified drift was seen but only a thin sheet of gravelly till with many small boulders of Archæan rocks. The underlying rocks are partly sandstone (Potsdam) and partly limestone (Calciferous probably), the latter resting on the former. The striæ on rock surfaces run from 12 degrees to 20 degrees east of north.

MARINE DEPOSITS AT FINCH.

From Smith's Falls eastward there is a gentle slope as seen from the railway, as far as Kemptville, with very thin boulder clay resting on limestone ; and much the same is true as far as Winchester, though some gently rolling till and some very level swampy tracts are passed also. The level has sunk from 424 at Smith's Falls to 235 when Chesterville is reached. The valleys of the Rideau and Nation rivers where seen from the railway are very shallow, those streams having done but little cutting since the Ice Age in this part of their courses. There is a rise to 270 feet at Finch, though the country has the same flat character with Cambro-silurian rock close to the surface, and a little boulder clay resting on it. Near Finch marine deposits become marked, showing as rather thin gravel ridges resting on till or on the bare rock. In many cases the ridges seem to be morainic, consisting of clay filled with boulders and having some gravel on top or heaped against the side of the clay. At Mr. D. J. McMillan's gravel pit one finds 12 feet of gravel overlying boulder clay. The gravel is fairly well rounded, rudely stratified and contains three sea shells in great numbers, *Saxicava rugosa*, *Macoma fragilis* and *Mytilus edulis*, the latter dropping to pieces. At the bottom of the gravel pit there is a layer

5 Sir J. W. Dawson, Can. Nat., Vol. X, New Series, pp. 386-7 ; and also The Canadian Ice Age, p. 268.

six or eight inches thick made up almost entirely of shells. Mr. McMillan states that some decayed bones have been found in the gravel but have been lost. In sinking his well the following section was found :

Gravel with shells	12 feet.
Stony blue clay, (one third stones)	10 "
Black sand and gravel	1½ "
Bed rock.	

This ridge of gravel, which is about a mile and a half south east of Finch, slopes gently off on all sides, but is longest from north to south and has a length of more than half a mile.

Similar gravel ridges are found at various points in the neighborhood. At the Stormont dairy farm for instance, there is a ridge about 200 yards wide and a mile and a half long consisting of 10 feet of gravel and stones, resting on 20 feet of hard pan. The direction of the ridges here is about 15 degrees east of north.

GRAVEL BEDS ON OTTAWA AND NEW YORK RAILWAY.

Gravel deposits occur also near Crysler's station on the Ottawa and New York railway near the Nation river. In the river valley near the station one finds 13 feet of very bouldery till with 8 feet of similar blue clay but with few boulders overlying it. A little below this the river falls six feet and has cut to that depth into the Trenton limestone. At Mr. J. Kennedy's gravel pit a mile and a half up the river from the station there is a ridge more than half a mile long and 200 or 300 yards wide rising from the river bank, which is here about 200 feet above sea level. The general level of the country is about 23 feet above the water, and the ridge rises to about 240 feet above the sea, the general direction being 20 degrees east of north. The pebbles and boulders of the deposit are roughly stratified and subangular, and consist almost altogether of limestone. The shells found in the gravel are not well preserved, but include *Saxicava rugosa* and *Macoma fragilis.*

Gravel ridges of the same kind are reported five miles to the west and two or three to the east of Crysler's.

About a mile west of Avonmore the railway cuts through a drumlin rising about 30 feet above the rather flat surface of the region. The cutting shows very stony blue till, the boulders being chiefly limestone but with some black shales, and the rounded hill measures nearly 300 yards from east to west and three quarters of a mile in length, its longest axis running 10 degrees east of north, about the usual direction in the region. The northern and southern extremities sink rather irregularly to the plain, so that the hill is not a well formed drumlin. A bed of shelly gravel a foot or two thick overlies the till at the highest part of the cutting. A higher morainic ridge lies about a mile south of Avonmore running in the same direction but covered with large boulders, many of them Archæan, and so far as seen without gravel containing shells. Between the two places, where a stream winds through the flat plain, sea shells are found once more, and many of the wells in the village show beneath clay a layer of sand, probably Saxicava, but a well being sunk at the gristmill near the railway showed only blue boulder clay, though at the time 40 feet deep.

Shells are said to occur at a gravel pit three miles southeast of Avonmore, but we found none. The materials are coarse sand and gravel with many boulders up to a foot and a half in diameter, the whole having the character of a kame rather than of a sea beach. Just to the northeast is a long, very stony, morainic-looking ridge running northeast and southwest, but not rising so high as the gravel ridge. The boulders are usually Archæan and many are several feet in diameter as seen in stone fences. A gravel ridge running in about the same direction is to be seen between North Star and Newington, but here we find stratified gravel with shells and many small limestone boulders.

THE WARINA BALLAST PIT.

One of the most interesting exposures of the region is at the Warina ballast pit to which a spur line runs from the C. P. R. at Monklands. A steam shovel is at work in the pit and has exposed a face of about 30 feet showing coarsely stratified gravel and sand, in the lower part holding many boulders, sometimes three or four feet in diameter, about half Archæan. The upper part of the pit looks more like a beach deposit, having thin layers of garnet sand and many shells of *Saxicava* and *Macoma*. It is said that underlying the gravel there is stony clay. The ridge where cut by the gravel pit is about a quarter of a mile wide from north to south and runs about north 35 degrees east, including an area of at least 100 acres. It rises 390 feet above sea level as shown by aneroid. A little south of the pit and 20 feet below it a well discloses blue boulder clay with scratched boulders of limestone and black shale. Farther south there is a ridge of sand running nearly east and west for about a mile and containing shells; and in the plain where Payne river, a tributary of Nation river, meanders one sees many shells. Here the banks of the stream show a little blue boulder clay in places, then from two to five feet of gray sand charged with the two common sea shells, *Saxicava* and *Macoma*, often covered by two or three feet of peaty muck containing sticks and logs. At the bottom of a ditch cut for drainage purposes the marine shells are thickly crowded at times and still retain their brown epidermis. In places a sandy layer containing many small fresh water shells of at least eleven species overlies the layer with sea shells with no distinct break between the two, and these shells run up into the overlying peat. There must of course have been a long interval after the marine shells were deposited before fresh water conditions could exist; but at present the two beds seem to run into one another and a single spadeful contains many shells of each kind.

A half mile further down the creek little or no boulder clay occurs and its bed is on the flat limestone, but here also occasional *Saxicavas* or *Macomas* are found on the rock. My attention was drawn to this shell bed by the kindness of Mr. J. A. Duff of the staff of the School of Practical Science, Toronto, who had charge as engineer of drainage works carried out in the region. Mr. A. H. Harkness, his assistant engineer, has also given valuable information on the shell deposits of this and adjoining parts of the district.

A railway gravel pit on the Canada Atlantic Railway at Moose Creek is said to resemble that at Warina and to contain sea shells; but this was not visited. Another gravel pit used by the Grand Trunk and Ottawa and New York railways occurs at the northwest corner of Cornwall township, shows much the same features as the Warina pit, and rises to about the same level, 390 feet above the sea, as shown by aneroid; though the thickness of gravel displayed is only 17 or 18 feet, resting on a floor of boulder clay. The deposit is an irregular ridge, a mile or more from east to west and about an eighth of a mile wide as seen in the pit. The materials are coarse, with many Archæan stones, and sea shells occur in the upper part. The gravel grows finer toward the south, changing to sand with stratification sloping southwards. Shells occur also in sand in the neighborhood of Newington.

The Newington peat bog, said to be four miles long and sometimes over a mile wide should be mentioned here. It is estimated to contain from 800 to 1200 acres, the peat being 20 feet thick. The bog stands higher than the adjoining cultivated land, and drains in various directions into the nearest streams. If the processes of making peat fuel now being introduced prove successful, this bog is well situated for the manufacture.

Mr. Duff states that openings for sewers, etc., in Cornwall show plenty of shells of the kind previously mentioned, at the height of 190 feet above the sea; and, as stated before, the skeleton of a dolphin, *Beluga catodon*, was found years ago in Saxicava sand at Cornwall.

STRATIFIED SAND AND GRAVEL AT OSNABRUCK

Stratified sand and gravel containing marine shells are found on lot 10, con. V of Osnabruck township and along a creek 2½ miles northeast of the village of Osnabruck Centre. This is near the watershed between the streams flowing to the Ottawa and the St. Lawrence. It will be noted that the watershed is surprisingly near the latter river, in fact not more than 6 or 7 miles from it. The region consists of gently swelling hills, occasionally covered with huge erratics reaching a diameter of 6 or 8 feet, but with many fields quite free from them. The level is from 300 to 350 feet above the sea. Some rather sharp and very stony ridges running about north and south are quite morainic in appearance, but most of the hills are more rounded and seem to be formed of boulder clay or ground moraine.

Some miles west of Osnabruck Centre, at Gallingertown, there is a gravel pit with shells, and the country is still rolling clay land ; but west of this the region becomes stonier for some distance. Near the village of Williamsburg in Dundas county a gravel pit contains many *Macomas* but no *Saxicavas.* The gravel is 8 to 10 feet thick with well rounded stones and is cross-bedded like a beach deposit. The shells are often in pairs and unbroken, and are found in all layers to the top, which is about 270 feet above the sea level. The general region is very flat with only gentle swells, the highest point being Bouck's hill to the east of Williamsburg. There are a good many boulders at some points, looking as if dropped by floating ice.

A gravel pit with similar shells occurs two miles west of the village also, rising about 280 feet above sea level. Just south of Irena a stony ridge runs about northeast and southwest, apparently a moraine, though with rather gentle slopes The hill is sandy at the southeast end but does not seem to contain shells.

PRESCOTT TO LYN.

At Prescott one sees boulder clay in trenches cut for sewers on St. Lawrence street, but at the railway station Trenton limestone rises almost to the surface. West of this along the railway ditches and in the fields there are several smooth surfaces of limestone showing striations, the direction being 5 to 10 degrees west of north. There are boulders scattered over the fields at some points suggesting an old water level or boulder pavement, and half a mile to the north what appears to be a shore cliff rises perhaps 60 feet, but no beach deposits were found. Still farther to the north there are sand dunes running nearly east and west and rising to about 360 feet above sea level, probably old beach sands shaped by the wind in later times into the present dunes. Shells are said to occur in these sands, though none were found by myself.

Two miles west of Prescott, at Gladstone, there is a large railway ballast pit showing a thickness of 40 or 50 feet of fine sand, gravel of various grades and well rounded boulders. The coarser parts are not bedded but finer parts have very long and steep lines of stratification like current bedding, the general appearance of the deposit being that of a kame. Small patches of silt and gravel resting unconformably on the kame-like beds contain unusually large shells of *Macoma fragilis* ; but no shells are found in the body of the gravel. The top of the gravel pit is about 5 feet above the level of the railway, or about 320 feet above sea level.

A mile and a half farther west there is a gravel ridge rising above the railway on the south side, apparently a beach ridge. In a pit sunk upon it ten feet of cross-bedded gravel containing fragments of *Macoma* rest upon a floor of blue clay ; and this point which is about two miles east of Maitland station and rises about 350 feet above the sea, is the most westerly gravel deposit where shells were found. Between this and Maitland there are stretches of bare rock on which well marked striae occur running 60 to 70 degrees east of north, a very different direction from that found at Prescott where they were a few degrees west of north.

At Brockville the drift now to be seen consists of rolling hills of boulder clay resting on thinly bedded Potsdam sandstone or on the Laurentian toward the western side ; but many years ago when the tunnel of the Brockville and Ottawa railway was being excavated beneath the town Dr. Bell found several species of marine shells in stratified clay, evidently Leda clay, the last reported occurrence of marine shells in the direction of lake Ontario.

The gravel pit at Lyn, nine miles west of Maitland and four west of Brockville, was visited in hopes of finding a continuation of the marine deposits ; but the railway gravel pit which is no longer in use, but still shows a good section of the drift, appears not to contain any fossils. The rocky floor on which the gravel rests is exposed as ice-rounded surfaces of Archæan having striations running 20 degrees east of north. The bottom of the pit is 300 feet (aneroid) above sea level and at one point stratified sand and gravel rise to 337 feet, while above this one finds boulder clay. At another point the stratified material is thicker, running up to 387 feet and followed by five feet of boulder clay on top. In general the lower part of the section shows coarse sand and gravel, with many subangular or rounded boulders making about half the height, and above this there is stratified sand covered by a varying thickness of very stony till. It is evident that the sand and gravel are interglacial in age, and it is not surprising that no marine or other shells were found. One of the former employees in the pit says that no shells have ever been found here, and that the pit has not been used for the last eight years.

The clay on top slopes back from the edge against a wall of thinly bedded sandstone forming a nearly level plain to the north. A cliff 20 feet high on the side of the adjoining creek valley shows the same sandstone in thin sheets interbedded with more rapidly weathering layers, probably containing carbonate of lime. The creek winds in a rather deep valley between this wall of sandstone (Potsdam ?) and bare, rather rugged hills of Archæan to the east. The stratified interglacial gravel probably once occupied most of the valley, but has been largely removed by the creek.

A Western Extension of the Ancient Sea.

Since lake Ontario stands only 246 feet above sea level, and beach-like deposits with shells belonging to the upper part of the Saxicava sand occur at a point only five or six miles east of Brockville at about 350 feet above the sea, one might fairly expect to find the same deposits running on into the basin of Ontario. Mr. F. B. Taylor in his map of the region at the close of the Ice Age represents the Gulf of St. Lawrence as reaching to Hamilton, covering the whole of the present lake,[6] and Dr. Spencer holds that the sea formed the Iroquois beach which surrounds the lake at an elevation of from 115 to 385 feet above the present surface of the water.[7] On this account it was thought wise to try to trace up the old beaches into the lake Ontario valley, so as to settle whether the sea had ever extended as far to the west as that.

No well marked water level was noticed at Brockville, but a fairly distinct is seen just west of Lyn, where fields of level clay occur between rocky hills at a height of 325 feet. Similar clay flats at about the same level extend along the railway westward from Lyn station and are found at Mallorytown, 8 miles beyond, at 337 feet above the sea ; and a still wider plain, with some islands of Archæan rock rising through it, occurs at Lansdowne where the height is 334 feet. West of this the plain is for a short distance several miles wide, but the railway then passes into Laurentian hills at Gananoque and the plain is lost. On the shore of the St. Lawrence at Gananoque there is a sand terrace rising to 292 feet, which is much under the previous levels, and may be a record of some lower stage of the water. West of Gananoque for some distance the location of the old water level is doubtful. Ballantyne station is on a plain, but is 362 feet above the sea ; and at Rideau (304), Kingston (275) and Collin's bay (280) the stations are considerably below the supposed water level. Whether the old sea level is marked to the north

6 A Short History of the Great Lakes, p. 18. 7 History of the Great Lakes, Spencer, p. 47.

of Kingston is not known ; but Professor Miller of Queen's University states that no terraces nor fossils, marine or freshwater, have been observed there.

At Ernesttown, after a gap of 35 or 40 miles, the railway traveller once more notices a wide plain suggesting a water level, now 327 feet above the sea ; but beyond this, at Fredericksburg (309) and Napanee (315), one is in doubt, since the gently rolling plain is somewhat too low and looks like a structural plain, the flat limestone showing itself often. At Deseronto (331) however what appears to be the original level occurs again and continues past Marysville (337) and Shannonville (336), as a broad flat plain underlain by horizontal limestone. Whether it should be considered as representing the old sea level is uncertain. At Belleville the railway dips down to the shallow Moira valley at 287 feet, but a plain looking very like an old water level, having upon it a sprinkling of boulders, probably a boulder pavement, rises to 323 feet (aneroid) a mile north of the city. Still farther north a well defined terrace rises to 416 feet against a mass of morainic hills, but this represents perhaps a stage in the fall of the Iroquois water and not a sea level.

At Trenton 12 miles west of Belleville one finds several fairly distinct beaches, the lowest, a gravel plain northwest of the Grand Trunk station, standing 285 feet above the sea (aneroid), a higher one at 390 feet, and the highest running from 592 to 640 feet above the sea. The last is of course the Iroquois beach, which is here strongly marked. Near Brighton also well defined beaches are found, the lowest at 309, and higher ones, belonging to the Iroquois or perhaps still earlier water levels, from 611 to 730 feet. The lowest beach is not nearly so well marked as the main Iroquois beach, but is nevertheless fairly distinct and in some places has a shore cliff rising 60 or 70 feet against the rolling boulder clay hills. Farther west at Colborne (323), Grafton (285) and Cobourg (297) plains suggestively similar to those mentioned and at not impossible levels form perhaps a continuation of the shore line. Beyond this it is doubtful whether any corresponding water level can be traced.

THE EVIDENCE OF THE SHELLS.

In concluding this rapid glimpse of a possible extension of the old marine beaches into the Ontario basin it should be stated that no fossils, either marine or fresh water, have been found in the deposits referred to, but at most points the examination has not been of a detailed or careful character. It is hoped that they may be worked out more fully at some future time in connection with a detailed study of the Iroquois beach.

In summing up one may say that fairly distinct beaches are found from point to point at levels between 350 and 285 feet in the 140 miles from Maitland to Cobourg, and that there is a tendency for the level to sink as one goes west, suggesting a differential elevation toward the east, though not so marked as in the higher Iroquois beach.

Although the levels as given do not exactly correspond, there seems to be a fair probability that they all belonged to the same body of water, and therefore that the sea once entered the Ontario basin, probably reaching almost to its western end, though in all likelihood not so deep towards the west as Lake Ontario is now because of the different tilt of the basin at that time.

It may fairly be asked why the sea shells stop at Brockville if there was uninterrupted water reaching into the western basin ; and a reasonable answer is that the large volume of fresh water poured into it kept the water too brackish for marine life, while the wider-mouthed gulfs to the east and in the Ottawa valley remained salt enough for the comfort of sea animals. If the Maitland gravel bar rising about 350 feet above the present sea level correctly represents the level at which the gulf of St. Lawrence stood in post-glacial times at the mouth of the Ontario basin, the outlet must have been comparatively narrow and not much more than 100

feet deeper than at present at the Thousand Islands, thus permitting the water above the strait to remain comparatively fresh. From the rather indefinite character of the old beach we may suppose that the sea did not remain long at that level, but gradually withdrew through the rising of the land toward the northeast.

AN ARGUMENT FROM STRATIFICATION.

Thus far the question of the level reached by the sea in eastern Ontario has been considered entirely from the evidence furnished by marine shells and other fossils, which have nowhere been reported above 470 feet, though they have been found at Montreal at an elevation of 560 feet above the sea. At the points nearest to lake Ontario where shells occur they are no more than 320 or at most 350 feet above the sea, the difference in level being probably accounted for by differential elevation toward the northeast.

There are however evidences of the action of water at much higher levels in the form of stratified clay and sand not known to contain fossils; and several geologists, such as Sir Wm. Dawson, Dr. Spencer, Mr. Chalmers, and Dr. Ells consider this sufficient proof that the sea stood at one time 1000 or more feet above its present level in eastern Canada.

Stratified blue clay, not unlike the Leda clay, but devoid of fossiliferous concretions occurs at many points in eastern Ontario at much higher elevations than those found along the Ottawa. Dr. Ells mentions clay which he considers of the same origin at Barry's bay on the Ottawa and Parry Sound railway, more than 900 feet above the sea;[8] and Mr Chalmers speaks of sands like the Saxicava sands at heights of 1000 to 1100 feet between Killaloe and Barry's bay; and of sand and gravel plains consisting of waterlaid materials on the C.P.R east of Toronto, at Myrtle, Burketon and Pontypool at a height of 1100 to 1200 feet.[9] If the sea once stood at these levels the gulf must have been wide and deep and probably connected with Hudson Bay, so that the water was probably as salt as elsewhere in the sea, and doubtless moved by tidal and other currents sweeping in the sea life from the open ocean. This occupation by the sea could not have been very short, for many of the deposits referred to are thick and widespread; and one is totally at a loss to account for the complete absence of marine fossils from them, when the shore gravels and the sands and clays formed by the sea at a later time and lower levels are often rich in fossils. Under the circumstances it seems to accord better with the facts to assume that these upper sand and clay beds were formed in bodies of fresh water, probably held up by the Labradorian ice sheet in its retreat at the close of the Ice Age; rather than to conclude that such great changes of level have occurred in the few thousands of years since the Ice Age. That an ice sheet of sufficient magnitude to retain large bodies of water existed in Canada is proved by the relationships of lake Agassiz in Manitoba and adjoining states. That this was a lake is proved by finding unios and other fresh water shells in its deposits; and that it was ice dammed is proved by the absence of any barrier between it and Hudson Bay. If ice could hold in position a lake larger than any of our present great lakes in the prairie region there is no good reason to deny that it may have done similar work in eastern Ontario.

List of Marine Fossils.

It will be of interest to gather together the list of marine fossils thus far reported from Ontario, making use especially of the work of Sir William Dawson and of Dr. Ami.[10]

---

8 Sands and Clays of the Ottawa Basin, Bul. Geol. Soc. Am., Vol. 9, p, 214.

9 Geol. Sur. Can., Vol. X, 1897, 68 and 69 A.

10 Canadian Ice Age, Sir Wm. Dawson; and Palaeontology of the Post-Pliocene Deposits of the Ottawa Valley. Dr. Ami, Ottawa Naturalist, Vol. XI, No. 1, pp. 20-26.

MAMMALS.

Phoca greenlandica (seal) Green's creek.
Beluga catodon (dolphin), Cornwall.
Megaptera longimana (whale), Smith's Falls.
Tamias striatus (chipmunk), Ottawa.

BIRDS.

Feathers and a limb bone, Green's creek.

FISH.

Mallotus villosus (capelin), Green's creek.
Osmerus mordax (smelt) "
Cottus uncinatus "
Cyclopterus lumpus (lump sucker) "
Gasterosteus aculeatus (?) (stickleback), Green's creek.

INSECTS.

Fornax ledensis, Green's creek.
Tenebrio calculensis "
Byrrhus Ottawaensis "
Phryganea ejecta "

OSTRACODES.

Estheria Dawsoni, Green's creek.

ANNELIDS.

Nereis pelagica, Green's creek.

MOLLUSCS.

Saxicava rugosa. Ottawa, etc.
Macoma fragilis, Ottawa, etc.
Macoma calcarea, Stormont county.
Mytilus edulis, Nepean, etc.
Nucula tenuis, Green's creek.
Nucula expansa, Pakenham ?
Leda pygmaea, Green's creek.
Leda (Portlandia) arctica, Ottawa.
Natica affinis, Graham's brickyard, Ottawa.
Cylichna alba or minuta, Green's creek.
Balanus Hameri, Nepean.
Balanus crenatus, Nepean.

STARFISH.

Asterias sp., Ottawa.

BRYOZOÖN.

Eschara elegantula, Odell's brickyard, Ottawa.

Iroquois Beach northwest of Trenton.

 Gravel Pit in Esker, Trenton.

Sand Dune near Brighton.

Flat Rock Falls, Upper Seine River.

SPONGE.

Craniella Logani Daws., Odell's brickyard, Ottawa.

PROTOZOA.

Polystomella crispa,	Odell's brickyard,	Ottawa.	
Dentalina sp.,	"	"	"
Nonionina sp.,	"	"	"
Discorbina sp.,	"	"	"

Most of these animals are still living in the Gulf of St. Lawrence, and the majority of them indicate that the waters of the ancient extension of the gulf were at about the same temperature as the present ; a few however suggest colder waters. It is curious to note that the four insects determined by Dr. Scudder from the Green's creek nodules are all considered to be extinct. The sponge and the ostracode also are held to be new species.

TREE AND PLANT REMAINS.

The 28 plants determined by Professor Penhallow from Green's creek and Besserer's grove, where they occur in concretions as do the fish, etc., include a number of trees as well as smaller plants, the list being as follows :

Acer saccharinum (sugar maple).
Algae sp. (seaweed).
Alnus sp. (alder).
Brasenia peltata.
Bromus ciliatus.
Carex magellanica (sedge).
Cyperaceae sp.
Drosera rotundifolia (sundew).
Elodea canadensis.
Encyonema prostratum.
Equisetum limosum (horsetails).
" scirpoides "
" sylvaticum "
Fontinalis sp. (moss).
Fucus digitatus (seaweed).
Gaylussacia resinosa.
Gramineae sp. (grass).
Hypnum fluitans (moss).
Oryzopsis asperifolia.
Populus balsamifera.
" grandidentata.
Potamogeton pectinatus.
" perfoliatus
" pucillus.
" rutilans.
Potentilla anserina.
Typha latifolia.
Valisneria spiralis.

Most of these plants are aquatic, a few marine seaweeds, but many plants growing in fresh water or in swampy places, probably drifted into the sea by rivers. Among the trees are the

sugar maple, the alder, and two poplars. Professor Penhallow concludes that "the vegetation, as a whole, is identical with that now found in the same region, from which we may infer similar climatic conditions." [11]

A considerable number of freshwater shells have been reported from deposits in the regions, but they probably belong to beds of a later age formed in lakes or streams above the marine beds. On this account they have not been enumerated here.

Age of Eastern Ontario Marine Deposits.

Sir Wm. Dawson, whose long continued and minute study of the marine fossils of the St. Lawrence and Ottawa valleys has so often been referred to in previous pages, thought these beds interglacial and put them in the same category as the Scarboro interglacial beds in referring to the fossil plants of Green's creek and Scarboro'.[12] In reality however they do not belong to the same period ; for the interglacial beds near Toronto were completed and deeply eroded before the last advance of the ice covered them with a sheet of boulder clay ; while the Leda clay and Saxicava sand rest usually on boulder clay and are apparently never covered by a later till sheet.

It is true that drift boulders occasionally rest on these beds as though dropped from floating ice, but we may suppose that before or even after the end of the last glacial retreat icebergs or floe ice carried them to their present positions. It is quite probable that river ice is now distributing boulders on the similar deposits at the bottom of the lower St. Lawrence. The climate appears not to have changed since the Leda clay was laid down, for all the plants occurring in it may be found living in the same region now, and it is quite possible that the Ice Age proper was entirely over before the marine beds were formed.

For those glacialists who believe the boulder clay to have been made by land ice, and this includes a large majority, the thawing away of the Labrador ice sheet and its withdrawal from the Ottawa valley must have taken place before the Leda clay was deposited, and hence the clays and sands with marine shells must be post-glacial. If the Iroquois water was ice dammed at the Thousand Islands, as most geologists think, the marine beds must be largely if not wholly of later age than that episode, since they occupy a region which must then have been ice-covered. This would place the beginning of their formation perhaps half way back towards the commencement of Niagara Falls, which is variously put at 5,000 to 32,000 years ago. According to these estimates the thick deposits of clay and sand must have been formed in from 2,500 to 16,000 years, and the sea must have withdrawn during that time to its present level hundreds of feet below the earlier one.

Possibly some estimate of the length of time necessary for the land to rise say 560 feet as at Montreal may be obtained by using Dr. Gilbert's data obtained from the changes in the tilt of the Great Lakes basins in the last 20 years, which indicate a rise of 0.42 feet per 100 miles per century, if one could make sure of the point where the differential movement begins toward the southwest.[13] If we arbitrarily assume the hinge to be 500 miles to the southwest, at the northeast end of the line the rate of elevation would be 2.1 feet per century, and the time required to rise 560 feet would be more than 2,600 years. However the data are so uncertain that the results are of very small value. Among the doubtful points one may mention the assumed uniformity in the rate of elevation. In all probability such changes begin exceedingly slowly, reach a maximum and then gradually die out. At what stage of the operation are we now, at the maximum rate of elevation, or near the latter end when the rate is slowing down ?

Another doubtful point is whether there are not hitches in the motion, halts of greater or less length followed by another advance. While the falling of sea level in the old gulf of eastern

[11] Can. Pleistocene Flora and Fauna, Rep. Com. B.A.A.S., Bradford, 1900.

[12] Can. Ice Age, pp. 271-274.

[13] Modification of the Great Lakes by Earth Movement, National Geographical Magazine, Vol. VIII., No. 9, p. 245.

Ontario seems to have been on the whole continuous, there are suggestions of halts at various stages such as the cut terrace at about 160 feet above sea near Besserer's wharf half a mile inland from the Ottawa river ; and the succession of marine terraces to be seen on the lower St. Lawrence as noted by Sir William Dawson at Montreal and other points down the river may be found to have their equivalents in Ontario when the region is more carefully studied.

If there were long halts in the elevation as would be implied in the formation of beaches and shore cliffs at levels below the highest, the estimate given above would require to be lengthened correspondingly. It should be understood of course that 2,500 years is the minimum time that can be assumed since the marine beds began to be formed, and that the probabilities favor a greater length of time.

The series of changes to be accounted for since the sea stood 350 or more feet above its present level near Brockville includes the formation of 140 or more feet of widely distributed stratified clay followed by 40 or more feet of even more widely spread stratified sand, the draining off of the sea, and the carving of river valleys like that of the Rideau, having a depth of at least 110 feet. Since the beds were formed and the sea has withdrawn, lake Ontario has been able to shape its shore line into its present mature form, requiring the cutting of cliffs hundreds of feet high and the building of gravel bars miles in length as at Scarboro' and Toronto ; and there appears to have been time also for four species of insects and two other animals to become extinct since the Leda clay was laid down at Ottawa. How long such changes require one can at present only guess, but they can hardly be assumed to have been carried out in the time since the founding of Rome, which would be implied in the lowest estimate given above ; and the highest estimate of 16,000 years does not seem too great.

Economic Products of the Drift

The best land of eastern Ontario is found on the areas of stratified and unstratified clay, the Leda clay and the till, the latter however providing often a somewhat stony soil. The Saxicava sand, occupying quite large areas, gives only a light soil, and the gravel ridges having sea shells of the same kind are in many cases covered by even less valuable land. The stratified clay and often the upper part of the till furnish excellent material for brick making, the former being worked extensively in the brickyards at Ottawa. The Saxicava sand, as in Nepean on the Rideau, provides sand for building and other purposes ; and the more gravelly upper members of this formation occurring as low ridges in many parts of the good farming districts afford welcome material for road-making in a region mostly covered with clay. The larger, more kame-like ridges, such as that at Warina, and the gravel pits south of Newington and at Gladstone are of value to the railways for ballast in a region otherwise not too well provided with materials for the purpose.

The only other economic material that need be mentioned is the peat occurring in large quantities at various points such as Newington and the region just north of Brockville. In the latter case a company has been formed to make use of a bog for the manufacture of fuel. The success of this enterprise may be hoped for when the initial difficulties in the preparation and marketing of a new fuel have been overcome. If this and the other companies undertaking the manufacture of compressed peat in various parts of the Province accomplish their design we shall soon be in a much stronger position in regard to the fuel problem than at present. The other uses of peat, as bedding, fibre, disinfectant, etc., have not yet been taken hold of to any important extent in Ontario.

INDEX